

A MULTILEVEL ANALYSIS OF SOCIOECOLOGICAL FACTORS ASSOCIATED WITH MODERN
CONTRACEPTIVE USE IN URBAN NIGERIA

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ABSTRACT

Chinelo Christine Okigbo: A Multilevel Analysis of Socioecological Factors Associated With Modern Contraceptive Use in Urban Nigeria
(Under the direction of Ilene S. Speizer)

An estimated 58,000 women died from pregnancy-related complications in Nigeria in 2015 alone. Family planning (FP) reduces maternal mortality through the prevention of unintended and high-risk pregnancies. Using the Socioecological Framework, this dissertation assessed modern contraceptive method use among women living in six cities in Nigeria: Abuja, Benin, Ibadan, Ilorin, Kaduna, and Zaria.

The first study estimated the determinants of modern method use among the women. Data from multiple cross-sectional surveys collected in 2010/2011 were linked to provide information on the intrapersonal, interpersonal, institutional, community, and societal socioecological levels. Multilevel logit models estimated the odds of modern method use among 15,947 women living in 488 clusters. About 21% of the women reported using modern methods. There were statistically significant direct and cross-level interaction associations between the socioecological factors and modern method use.

The second study examined the associations between changes in gender-equitable norms and changes in modern method use among the same women followed over time. The analytical sample included 9,933 women living in 480 clusters. Multilevel multinomial models estimated the associations between the change in modern method use and changes in gender-equitable norms towards: wife beating; household decisions; couples' FP decisions; and FP self-efficacy. The use of modern methods increased from 21% to 32% during the study period. Positive changes in the gender-equitable norms towards household decisions, couples' FP decisions, and FP self-efficacy were significantly associated with increased probability of modern method adoption and continued use and decreased probability of discontinuation during study period.

These findings highlight the need for multilevel interventions to improve modern contraception in urban Nigeria. Such FP interventions should be tailored to the characteristic of the target communities.

To Ezeudo, continue to rest in peace.

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LIST OF ABBREVIATIONS

AIC	Akaike Information Criteria
CI	Confidence Interval
CPR	Contraceptive Prevalence Rate
DHS	Demographic and Health Survey
FP	Family Planning
GDP	Gross Domestic Product
GIS	Geographic Information System
GLLAMM	Generalized Linear Latent and Mixed Models
HIV	Human Immunodeficiency Virus
ICC	Intra-cluster Correlation Coefficient
ICPD	International Conference on Population and Development
LGA	Local Government Area
LR	Likelihood Ratio
MCPR	Modern Contraceptive Prevalence Rate
MDG	Millennium Development Goals
MLE	Measurement, Learning and Evaluation
MMR	Maternal Mortality Ratio
MNCH	Maternal, Neonatal, and Child Health
MOR	Median Odds Ratio
NAPEP	National Poverty Eradication Programme
NDHS	Nigeria Demographic and Health Survey
NGO	Non-Governmental Organizations
NURHI	Nigerian Urban Reproductive Health Initiative
OR	Odds Ratio
RRR	Relative Risk Ratio
SD	Standard Deviation

SDG	Sustainable Development Goals
SMI	Safe Motherhood Initiative
VIF	Variance Inflation Factor

CHAPTER 1: INTRODUCTION

Maternal Mortality – A Global Health Priority

Since the late 1980s, there has been a renewed interest to reduce maternal mortality globally. Several international health initiatives were established to encourage the global discourse on maternal health. The Safe Motherhood Initiative (SMI), Millennium Development Goals (MDG), and Sustainable Development Goals (SDG) are examples of international agreements that call on national governments, funding agencies, and non-governmental organizations (NGO) to dedicate efforts towards reducing the rate of maternal deaths [1-3]. The maternal mortality ratio (MMR), the number of women who die from pregnancy-related complications per 100,000 live births during a given time period, is a population-based indicator of maternal health. International health initiatives have used MMR to monitor the progress towards achieving their goals. For instance, the 1987 SMI aimed to halve the MMR by the year 2000 while the fifth MDG (MDG 5) aimed to reduce the 1990 MMR by three-quarters by 2015 [1-3].

To date, considerable progress has been made towards reducing MMR worldwide. The global MMR decreased by approximately 44% between 1990 and 2015; however, this percentage fell short of what was needed to achieve the MDG 5 target [1, 2]. Of the 189 United Nations member states, only nine achieved the MDG 5 target by 2015 [2]. The SDG, set in 2015, build on the MDG and are comprised of 17 goals with multiple targets to be achieved by the year 2030 [2, 4]. The SDG focus on many aspects of development such as ending extreme poverty, ill-health, inequality, injustice, and climate change. Although all the SDG have impact on maternal health, SDG 3 (ensure healthy lives and promote well-being for all at all ages) and SDG 5 (achieve gender equality and empower all women and girls) have targets that directly measure maternal health indices [4]. Both goals have the target to “*ensure universal access to sexual and reproductive health and rights*”. SDG 3 has an additional target to “*reduce global MMR to less than 70 per 100,000 live births by 2030*” [4].

In 2015, an estimated 303,000 women died from pregnancy-related complications worldwide, resulting in an estimated global MMR of 216 maternal deaths per 100,000 live births [1, 2]. Sub-Saharan Africa accounted for about 66% of the global MMR [2]. Like most sub-Saharan African countries, Nigeria – a West African country – did not meet the MDG 5 target [1, 2]. The MMR in Nigeria decreased by about 40% from 1,350 maternal deaths per 100,000 live births in 1990 to 814 maternal deaths per 100,000 live births in 2015 [2]. In 2015, Nigeria had the highest absolute number of maternal deaths in the world – 58,000 maternal deaths [2]. It is estimated that a woman living in Nigeria has a 1 in 22 chance of dying from maternal causes during her lifetime; the risk is 1 in 5,800 for a woman living in the United Kingdom and 1 in 3,800 for a woman living in the United States of America [2]. According to the 2004 National Policy on Population for Sustainable Development, the Nigerian Government aimed to reduce the MMR to 125 deaths per 100,000 live births by 2010 and to 75 deaths per 100,000 live births by 2015 [5]. Both targets were not achieved as the estimated 2015 MMR was about 7 times and 11 times higher than the 2010 and 2015 targets, respectively. Nigeria signed on to achieve the SDG 3 target of reducing the MMR to below 70 maternal deaths by 2030 [2]. To do this, there is a need for evidence-based maternal health interventions in Nigeria.

According to the World Health Organization, the major direct causes of maternal morbidity and mortality are perinatal uterine bleeding, perinatal infections, high blood pressure during pregnancy, and unsafe abortions [6]. One way to reduce the risk of maternal death is through family planning (FP). FP prevents maternal deaths through the reduction in the total number of childbirths, high-risk pregnancies and childbirths, unintended pregnancies, and unsafe abortions [7-11]. Ahmed et al. (2012) estimated that, in 2008, FP averted about 272,000 maternal deaths worldwide – a 44% reduction in the 2008 global MMR [12]. In Nigeria, about 24% of all pregnancies that occurred in 2012 were unintended and about 56% of those unintended pregnancies ended in abortion [13]. An estimated 1.25 million induced abortions occurred in 2012 in Nigeria resulting in an induced abortion rate of 33 abortions per 1,000 women aged 15-49 – an increase from the 1996 rate of 23 abortions per 1,000 women aged 15-49 [13]. A majority of these unintended pregnancies and the subsequent induced abortions could have been prevented through the accurate and consistent use of effective contraceptive methods. Thus, optimizing the practice of FP in

Nigeria has the potential to further reduce the prevalence of unintended pregnancies, induced abortions, and maternal mortality, consequently leading to improved maternal health.

Family Planning – Essential to Maternal Health

Since the 1994 International Conference on Population and Development (ICPD), FP has been recognized as a human right [14, 15]. Principle 8 of the ICPD Programme of Action states that “*couples and individuals have the basic right to decide freely and responsibly the number and spacing of their children and to have the information, education, and means to do so*” [15]. As such, the World Health Organization defines FP as the practice of attaining the desired number and spacing of children, which is achieved through the use of contraceptive methods and/or treatment of infertility [16]. There are two types of contraceptive methods: modern and traditional methods. The modern contraceptive methods, hereafter referred to as modern methods, include those methods that were developed and/or refined in the last six decades to effectively provide protection against getting pregnant [17]. These methods include surgical procedures such as tubal ligation and vasectomy (female and male sterilization, respectively); barrier methods such as female and male condoms, diaphragms, and spermicides; intrauterine devices; hormonal methods such as daily pills (combined estrogen and progesterone pills, progestin-only pills), injectables, implants, and emergency pills; lactational amenorrhea method; and standard days method. The traditional contraceptive methods, hereafter termed traditional methods, include coitus interruptus also known as withdrawal method, rhythm method, and other folk methods.

The practice of FP has been shown to have several benefits to women and their families. In addition to the reduction in maternal mortality and morbidity, FP improves child health by prolonging the inter-pregnancy interval, which in turn prevents maternal anemia [9, 10] and prevention of sexually transmitted infections depending on the method [7]. Some of the other benefits of FP that are not health-related include women’s empowerment through increased education and subsequent engagement in the workforce [7, 9, 18]; and environmental sustainability through population control [19, 20]. Despite these benefits, not all women who want to avoid pregnancy use contraceptive methods. The contraceptive prevalence rate (CPR), defined as the percent of women aged 15-49 years who are using a contraceptive

method at a specified time, is a commonly used indicator for assessing the practice of FP at the population level [21]. The global CPR increased from 55% in 1990 to 63% in 2010; in Africa, the CPR increased from 17% in 1990 to 31% in 2010 [22]. According to the Nigerian Demographic and Health Surveys (NDHS), which are nationally representative cross-sectional surveys conducted every three to five years, the CPR trend in Nigeria has been on the rise since 1990 but remains low. Among married women in Nigeria, the CPR increased from 6% to 15% between 1990 and 2013 [23, 24]. The majority of that increase was in the use of modern methods, which increased from 3.5% to 9.8% within the same period. However, most of the increase in modern method use happened in the 1990s – 3.5% in 1990 to 8.6% in 1999 [24]. Since the 2000s, the CPR in Nigeria has stalled. There was about a one percentage-point increase between 1999 and 2008; however, the CPR among married women remained the same between 2008 and 2013 – 10% for modern methods and 5% for traditional methods. Other community-based studies from different parts of the country found similar results [25-27]. The stall in the CPR trend suggests that there may be obstacles to the use of FP in Nigeria.

Defined as the proportion of women of childbearing age who are in union, are fecund, desire to delay or stop childbearing but are not practicing contraception, unmet need for FP in Nigeria has remained higher than CPR since the 1990s [21-23, 28]. It is postulated that satisfying the unmet need for FP has the potential to reduce MMR by one-third [10, 12] and prevent about 10% of child mortality [19]. Several factors have been cited as drivers of the unmet need for FP and they include, but are not limited to, insufficient knowledge about FP methods; limited access to FP services; and perceived social barriers to use of FP methods [28, 29]. In 2014, the Nigerian Government developed a five-year FP scale-up plan to increase CPR from 15% in 2013 to 36% by 2018 [30]. It was estimated that increasing the CPR to 36% would avert 1.6 million unintended pregnancies and 1.1 million infant and child deaths in Nigeria [30]. To achieve these targets, it is essential to understand the factors that influence the use of FP in Nigeria.

Determinants of Modern Contraception

The determinants of modern method use can be classified into two groups: barriers and facilitators. The barriers are those factors that prevent the translation of contraceptive need to

contraceptive adoption; while the facilitators are described as factors that encourage use of FP methods among those who want to prevent pregnancy [10, 31]. According to Campbell et al. (2006), *“the presence or absence of barriers to fertility regulation is likely an important determinant of the pace of fertility decline or its delay in many countries”* [31]. More so, international agreements on reproductive health such as the ICPD Programme of Action emphasize the importance of eliminating obstacles to the practice of FP in the continued efforts to improve population health [15]. Several factors that affect the use of modern methods have been described in the FP literature, mostly from developing countries [17, 29, 31, 32]. A majority of these studies focused on how the characteristics of the woman influence her propensity to use a modern method [25-27, 33-35]; while a few others examined the effects of the household and/or community characteristics on her likelihood of practicing modern contraception [36-39]. Although some of the factors have consistent effects on modern method use, e.g., wealth has a positive association with modern method use [24, 37], other factors have inconsistent effects on modern method use, e.g., age had a positive association in some studies [40, 41] and a negative association in others [37, 42-44]. This inconsistency could be explained by the co-existence of numerous factors within a woman’s social and physical environments so that the combined effects of the factors may produce positive, negative, or no net effect on her probability of using modern methods. This dissertation assessed the determinants of modern method use among reproductive-age women in urban Nigeria. These factors were hypothesized to exist on multiple social and physical levels as described by the Socioecological Framework.

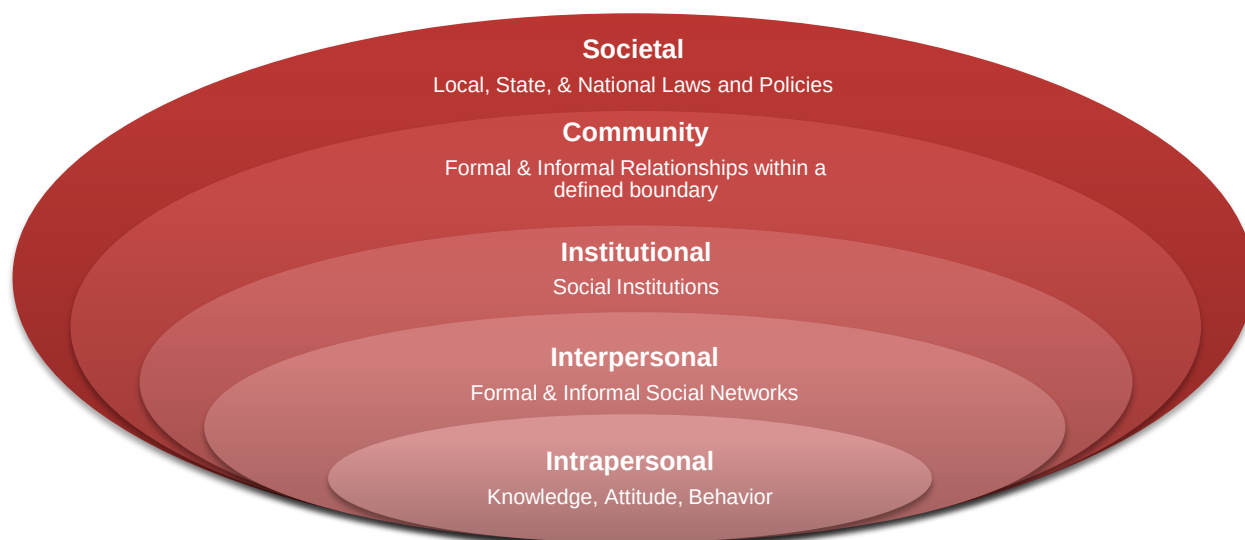
Determinants of modern contraception within the Socioecological Framework

The Socioecological Framework was developed by Urie Bronfenbrenner in the 1970s; the framework describes how the process of human development is affected by the relationships within and between the physical and social environments [45, 46]. Bronfenbrenner classified these environments into four systems that are nested within each other: microsystem, mesosystem, exosystem, and macrosystem. The microsystem describes the complex relations between an individual and his/her immediate environment such as the home or the workplace, including the social interactions with the people in such places. For example, a woman’s attitudes towards use of modern methods may be influenced by her partner’s views on FP. The mesosystem is a compilation of microsystems. For instance,

if the woman whose partner does not support FP also works in an office where the health insurance plan does not cover FP services, her likelihood of using a contraceptive method may be further reduced. The exosystem comprises of other environments that are not directly related to the individual but exert influence on the individual. For example, a woman who lives in a community where the health facilities do not provide quality FP services may not consider obtaining modern methods from the health facilities even though she has never experienced the poor quality of services. The microsystem, mesosystem, and exosystem are embedded in the macrosystem, which includes the overarching institutions such as legal and cultural systems. For instance, living in a patriarchal or pronatalist community may decrease a woman's likelihood of practicing contraception by negating her attitudes towards FP.

Bronfenbrenner's framework was initially developed in the context of child development but has been applied to other aspects of human development. For example, McLeroy et al. (1988) adapted the Socioecological Framework to health behavior and promotion [47]. The adapted model has five levels derived from the four systems of the original model. The adapted model separated the microsystem into two levels, intrapersonal and interpersonal levels, to represent the characteristics of the individual and the relationships with the other people in the immediate social and physical environments, respectively. The mesosystem still exists in the adapted model, though not graphically represented. The exosystem was also separated into two levels, institutional and community levels, while the macrosystem represented the societal level in the adapted model. Thus, the socioecological levels in the adapted model are as follows: intrapersonal, interpersonal, institutional, community, and societal levels (see *Figure 1.1*). These levels are embedded within each other to reflect their hierarchical nature and the reciprocal relationships among the factors that exist within them. In using the Socioecological Framework, specific core principles are maintained. The model should: a) be behavior-specific; b) include factors that exist at multiple levels; c) elicit direct and interaction effects of the factors; and d) show how multilevel interventions will be effective in changing the behaviors [47]. In this dissertation, the behavior of interest is the use of modern methods; the associations between the socioecological factors and the behavior of interest were estimated using multilevel mixed effects models.

Figure 1.1: The Socioecological Framework



Intrapersonal factors associated with modern method use

In this dissertation, the intrapersonal level includes the characteristics of the woman that affect her probability of using a modern method. A review of the literature showed that many studies focused on this level. The factors often studied were the woman's age, marital status, education, religion, wealth, parity (number of children ever born), employment, and knowledge of and efficacy to use FP.

- **Age of the woman:** Several studies showed associations between a woman's age and her probability of using a modern method [26, 34, 40, 42, 41, 48]. However, the direction of association was inconsistent. For example, several studies found that age was positively associated with modern method use [26, 41] while others found a negative association [42]. The discrepancy in the association between age and modern method use may be attributed to the effects of other factors within the woman's socioecological context that may not have been accounted for. Furthermore, some studies found a non-linear association between age and modern method use [48, 49]. Adebayo and colleagues (2013) found that, in Nigeria, the use of modern methods increased with every unit of increase in age up to age 24 for never-married women and age 38 for ever-married women after which it steadily declined [49]. Another study found that modern method use was lowest at the extremes of reproductive ages (<20 years and >40 years) compared to those aged 20-39 years [48].

- Marital status: Just like age, the effect of marital status on modern method use was not consistent. Some studies found that unmarried women were more likely to use modern methods compared to married women [49, 50]; while others found that married women were more likely to use modern methods compared to unmarried women [25, 26, 51]. This inconsistent effect of marital status on contraceptive behavior may relate to the prevalence of non-marital sexual activity in different settings. It may be that in settings with low prevalence of non-marital sex, being married is positively associated with modern method use given the higher risk of pregnancy within marital unions. While in settings where non-marital sex is prevalent, unmarried women may have higher odds of modern method use while their married counterparts may have lower odds of modern method use especially among those whose spouses discourage use. A recent study in Ghana found that marital status also predicted the choice of modern methods as married women preferred non-barrier methods such as injectables while unmarried women preferred barrier methods such as male condoms [50].

- Level of education: Education was found to have a consistently positive association with use of modern methods [24-26, 37, 38, 42, 44, 52]. This positive influence was more evident from secondary education [25, 26, 38, 40, 44]. However, it was unclear whether the association between education and modern method use was mediated by FP knowledge. Education and knowledge of FP are likely correlated as educated women, compared to non-educated women, may be more likely to comprehend FP messages such as the mechanisms of action and side effects of the different methods,.

- Religion: Several studies found a negative association between being Muslim and using modern methods [11, 33, 34, 42, 44, 49, 53, 54]. However, Addai (1999) found that among married women in Ghana, the association between religion and contraceptive use was mediated by other socioeconomic factors such as education, residence, and parity [33]. Shaikh et al. (2013) reported that FP is permissible in Islam [55]. Thus, it is likely that other sociocultural factors within Islamic communities are discouraging the use of FP as postulated by Izugbara et al. (2010) in their study conducted in the Islamic northern region of Nigeria [53].

- Wealth: Many studies have found positive associations between wealth and the use of FP as women of higher wealth status are more likely to use a modern method compared to those of lower wealth status [24, 34, 37, 42]. The rationale is that, compared to poor women, wealthier women will be

more likely to afford FP services. However, other socioeconomic factors such as education and residence may also be driving this positive relationship.

- Parity: There is a relationship between the number of children a woman has and her likelihood of using a modern method. Studies have found that women with higher parity are more likely to use a modern method compared to those with lower parity or no living children [11, 34, 41, 42]. In addition, parity has been shown to influence the type of modern method used as women with higher parity tend to use longer acting methods such as implants and intrauterine devices compared to those with lower parity who use shorter acting methods such as injections [56, 57].

- Ideal family size: It is hypothesized that as the number of children a couple plan to have (ideal family size) decreases, the demand for contraception increases and vice versa [37, 58]. Evidence suggests that ideal family size is highest in sub-Saharan Africa and may be responsible for the high fertility rate and low use of contraceptive methods observed in the region [58, 59]. A 2014 study on the trends of contraceptive use in 22 sub-Saharan African countries found that the ideal family size was highest among women who had no need for contraception and lowest among those using a contraceptive method [59]. In Nigeria, research indicates that large family size is still desirable, which may be contributing to the low level of modern method use [23, 24].

- Employment: This factor relates to wealth as women who have paid employment tend to have more economic access to FP services as they can afford transportation to the health facility and the cost of FP services [9, 43, 51]. In addition, employed women may have more exposure to FP messages at their work place or through their colleagues and may have more power to make the decision to use modern methods. Likewise, these women may have more motivation to practice contraception if they want to continue working without interruption.

- Knowledge of and attitudes towards FP: Most studies on FP assess the knowledge of and attitudes towards contraceptive methods [24, 27, 39, 44]. In Nigeria, studies have consistently found that the knowledge of modern methods is almost universal but use continues to be low [23-25, 60, 61]. According to the 2008 and 2013 NDHS, the percent of reproductive-age women aware of FP increased from 71% in 2008 to 85% in 2013; however, modern method use remained constant at 10% [23, 62]. Thus, the hypothesis that knowledge translates to use, probably through increasing the woman's efficacy

to practice FP as was found in Vietnam [35], does not seem to apply in the Nigerian context. This indicates that other barriers to FP use, such as negative attitudes towards FP, may be more prevalent. Attitudes towards FP have been linked to use of modern methods in sub-Saharan Africa; individuals who approve of FP are more likely to use modern methods than those who do not approve of FP [25, 44, 63]. A recent study among women living in urban Nigeria found that inaccurate knowledge of and concerns about the side effects of modern methods were negatively associated with the use of modern methods [64]. The misconceptions and concerns about these modern methods increase FP disapproval. The 2008 NDHS reported that FP disapproval was the most prevalent reason (20%) married women gave for not using or intending to use a modern method [62]. Fotso et al. (2011) in their study about the levels and trends of FP in urban Nigeria found that FP approval was positively associated with level of education and wealth and was found to be higher in the Southern regions compared to the Northern regions of the country [24]. These findings indicate that attitudes towards FP may be mediating the association between socioeconomic factors and modern method use. A study conducted by Dube and Mohammed (2006) among Nigerian men in northern Nigeria found that attitudes towards FP had the largest direct effect on contraceptive use and that it mediated the effects of other demographic and economic factors (such as age, education, income, number of living children, and family planning knowledge) on contraceptive use [27]. Likewise, exposure to a FP program is likely to increase the knowledge of contraceptive methods and promote positive attitudes towards FP.

- Self-efficacy: This measure, as defined by Bandura (1977), is one's perceived ability to successfully carry out a behavior in order to achieve a desired outcome [65]. This measure is believed to be central to adopting a behavior and is a key construct in several health behavior theories such as the Social Cognitive Theory, Theory of Planned Behavior, and Health Belief Model [66-68]. Many studies have found positive associations between a woman's perceived self-efficacy towards FP use and her likelihood to use modern methods [35, 68, 69].

- Women's empowerment: It is believed that women who are empowered financially and socially are more likely to participate in decisions that affect their lives and that of their families [70]. As a result, research has examined the association between women's empowerment and use of contraceptive methods. Many studies have found that women's participation in household decision-making, a measure

of empowerment, increases their likelihood of using modern methods [70-72]. On the other hand, the experience of or the attitudes towards gender-based violence impact women's autonomy and ability to seek health services including FP services; studies show that tolerant attitudes towards wife beating are negatively associated with modern method use [72-74]. A study in southern Nigeria discovered that about two-thirds of both male and female respondents did not support women having independent rights to method choice, adoption, and use [75]. Also, some women require permission or approval from significant others to use modern methods; this further decreases their likelihood of using a modern method.

Interpersonal-level factors associated with modern method use

At the interpersonal level, it is expected that the characteristics of the people within a woman's social network and her interaction with them affect her contraceptive behavior. These people include her partner and other close relations such as her mother-in-law, friends, neighbors, and peers. Many of the studies that included factors at this level assessed the influence of the male partner [19, 39, 48, 50, 76, 77] while others assessed that of friends and other family members [44, 78, 79]. Researchers have found that women who discuss the use of contraceptive methods with their male partners are more likely to use or intend to use a modern method [36, 38, 39, 44, 76]. Odimegwu (1999) found that married women in Nigeria who discussed FP with their spouses were three times more likely to use a method than those who did not [44]. Another study found that among urban women in Nigeria, spousal communication about fertility intentions increased the desire to cease childbearing [69]. Another key factor at this level of influence is the partner's approval or disapproval of FP [19, 38, 39, 48, 50, 77]. This factor is usually measured based on the woman's perception. Perceived partner's opposition to FP use has been found to be negatively associated with the odds of a woman using a modern method. For example, Teye (2013) found that among women in Ghana, perceived partner's disapproval of FP was a prevalent reason for non-use of modern methods [50]. Kaggwa and colleagues (2008) in their study among married women in Mali found that those who perceived their partners approved of FP were twice as likely to use a modern method compared to those who did not [39]. Izugbara and colleagues (2010) conducted focus group discussions and in-depth interviews with men and women in Northern Nigeria to explore the barriers to spousal communication about FP [53]. They found that many couples did not discuss FP because of

gender-specific incentives: men did not want their wives to doubt their fidelity while women believed that having many children stabilized their marriage by preventing their husbands from marrying additional wives. This discrepancy in husbands' and wives' perception of each other further reinforces the need for spousal communication.

Living in a patriarchal society, such as Nigeria, highlights the influence of men's reproductive intentions or FP attitudes on their female partners' reproductive behaviors. Isiugo-Abanihe (1994) found that having a male-dominant view was positively associated with preferences for large family size in Nigeria and negatively associated with modern method use [76]. Men's FP attitudes do not only affect adoption of a modern method but also affect continued use. A facility-based study among contraceptive implant users in Nigeria found that 7% of the women discontinued use because their husband asked them to [57]. Additionally, women's attitudes towards modern method use are affected by the attitudes of other people in her immediate social environment, such as her friends and neighbors [69, 79]. A study among urban slum residents in southwest Nigeria found that young women (15-24 years) were more likely to use condoms if they perceived support from their friends and non-parental adults [69]. Likewise studies from southeast Nigeria found that friends and peers were the main source of contraceptive information for young women aged less than 25 years [80, 81]. Another Nigerian study found that women were more likely to use a modern method if they perceived approval from others such as their mother-in-law or closest friends [44]. Hence, it can be concluded that a woman's likelihood of using a modern method can be influenced by the FP attitudes of those with whom she has close interactions. In this dissertation, the women's interaction with their male partners about FP and their perception of others approval of FP were included at this level.

Institutional-level factors associated with modern method use

This level includes characteristics of social institutions available to the woman such as health facilities within her community. This level also includes the formal and informal rules and regulations that guide the operations of such institutions or the services they provide [47]. The quality of FP services have been linked to modern method adoption and continued use [63, 82-84]. According to Judith Bruce (1990),

the quality of FP service provision can be measured by assessing these six elements: choice of methods, technical competence, information given to clients, provider-client interaction, mechanisms to ensure follow-up and continuity, and appropriate constellation of services [85]. A literature review of facility-based studies assessing barriers to fertility regulation indicated that among the most prevalent barriers to FP use were limited choice of methods, provider bias, and other medical restrictions on eligibility to use modern methods [31]. These barriers were usually experienced at the health facility. Keep in mind that these are women who had decided to use a modern method, with or without their partners' approval, and made the effort to go to a health facility to receive the method but were denied access. Evidence suggests that outdated contraindications, eligibility barriers, appointment scheduling hurdles, and provider bias are some of the reasons women do not receive modern methods at health facilities [82].

A study in the Philippines found that high quality FP services at the time a woman adopted a modern method increased her odds of continued use at a follow-up visit more than a year later [83]. The authors also found that the predicted probability of using a modern method steadily increased with the quality of FP services. In urban Uganda, it was found that the presence of a health facility and health providers who recently received FP training doubled the adoption and use of modern methods [41]. Studies conducted in Morocco found that the probability of adopting a modern method increased with the presence of a nearby health facility, number of trained providers in a nearby health facility, and the methods available in a public health clinic [43, 86]. Levin et al. (1999) found that the travel time to a health facility was negatively associated with modern method use in Bangladesh [34]. Although, the authors did not find an association between cost of services and contraceptive use, they found that cost of services influence method choice and type of provider. A recent study in Nigeria found that women's report of access to health facilities within the community (defined as having a hospital visit in the 12 months prior to survey) had a positive association with modern method use [87]. Mandara (2012) in her review of FP in Nigeria suggested that the high stock-out rate of contraceptive commodities and poor attitudes of healthcare providers contributed to the low use of FP services in Nigeria [88]. Some groups of women have been shown to be more vulnerable to these medical barriers than others. For example, a 2008 descriptive study of emergency contraceptive users in southeastern Nigeria found that about one-quarter

of unmarried young women could not obtain emergency contraceptive pills due to the negative attitudes of health providers [81]. These health providers believed that young unmarried women should not be sexually-active and should not need contraception. Such barriers further increase the unmet need for FP for the women. In this dissertation, access to FP services in nearby facilities were included at this level.

Community-level factors associated with modern method use

As defined by Kravdal (2002), social learning is the acquirement of knowledge and attitudes about a particular subject through direct observation of and communication with other people while social influence is the reflexive imitation of other people's behavior driven by a desire to gain their approval [52]. These two concepts are essential in assessing the effect of factors at this level of influence on a woman's contraceptive behavior. The FP norms and behaviors of community members may influence women's contraceptive behaviors through social learning and influence. In Nigeria, Isiugo-Abanihe (1999) found that the typical male-dominant and patrilineal traditions and norms support large family size and discourage the use of contraceptive methods [76]. Fotso et al. (2011) found that in urban Nigeria, men and women desired large family size – the mean ideal number of children was five children for women and six children for men [24]. The ideal number of children is often used as a proxy for future fertility; thus based on the Fotso et al. study, an average couple in urban Nigeria will not consider contraception until they have had at least five children, which is more than twice the population replacement rate.

Studies that considered community effects have mainly used individual-level factors aggregated at the cluster level as a proxy for the community [36-39, 52, 89-93]. Such studies considered the following factors as having effects on women's probability of using modern methods: rural/urban residence [35, 42, 94]; mean ideal number of children [63]; mean actual number of children [39]; mean educational level at the community [38, 52]; mean community wealth index [37, 38, 91]; proportion of people who are Muslim [52]; proportion of women with high decision-making power [52]; proportion of men and women who approve of FP [38]; proportion exposed to FP messages [36, 39]; and community social and gender norms [36, 64, 89, 90]. Elfstrom and Stephenson (2012) found that in Nigeria, women who lived in communities with a high mean ideal number of children were less likely to use a modern method

compared to those who lived in communities with lower mean ideal number of children [37]. Several other studies in Nigeria found a north-south regional divide as women in the northern region had lower odds of modern method use compared to those in southern region of the country [23, 24, 49, 62, 92]. In addition, studies have found that rural women had lower probability of modern method use compared to their urban counterparts [14, 35, 42, 94]. But with the recent growth in urban poverty, there is an increasing concern that many urban residents may have lost their historical social advantage over the rural residents [33, 95]. Moreover, poverty in urban areas is impeding access to FP services; this low access to FP services may be contributing to the high urban growth rate [95, 96]. Young people make up the majority of the rural-to-urban migrants as they seek opportunities for education and employment. These young people are in their reproductive ages and hence in need of reproductive health services including FP services. A recent study in Nigeria that estimated community influences on modern method use found no statistical difference between urban and rural residents in their odds of using modern methods [87].

Additionally, community characteristics are said to have more direct policy implications compared to individual characteristics [38, 91]. FP policies and programs designed to improve access to FP services and commodities are usually implemented at the community level, so it makes sense to assess the impact of such policies and programs on the entire community. Additionally, since the attitudes and behaviors of the community members have an effect on the likelihood of a woman using a modern method, implementing community-wide programs to change such views and behaviors is likely to have greater impact on a woman's use of modern methods compared to trying to change only the woman's attitudes and behaviors. Such community-level interventions may also be cost-effective compared to individual-level programs. Notably, community-level analysis tends to provide a broader perspective of the progress, or lack therefore, of any intervention as it averages out the individual nuances.

Societal-level factors associated with modern method use

The local, state, and national laws and policies that guide the provision of FP services exist at this level of influence. Evidence suggests that the presence of national FP programs and/or policies together with strong governmental commitment increase access to and use of modern methods and decrease the

level of unmet need for FP [97-99]. The implementation of other development policies, such as education and/or poverty alleviation policies, also influences FP. For instance, it was found that the implementation of widespread primary education policy in sub-Saharan Africa led to considerable increases in modern method use and decreases in fertility rates [100]. Besides, the implementation of national FP programs have led to decreased fertility and is contributing to population stabilization [19].

Social theories explain contraceptive adoption

Several relationships are hypothesized between the factors that exist on the multiple levels of the Socioecological Framework and modern method adoption and use. These hypotheses are supported by several psychosocial theories such as Social Cognitive Theory and Theory of Gender and Power. The Social Cognitive Theory was developed by Albert Bandura in the 1970s and posits that the adoption and maintenance of behaviors are a result of the dynamic interaction of the person, the environment, and the behavior [101, 102]. The theory, initially termed Social Learning Theory, postulates that behaviors are learned from observing other people carrying out the behavior; this theory was renamed after the incorporation of concepts from Cognitive Psychology that highlight the roles the individual's past experiences and self-regulation play in behavior adoption and maintenance [66, 102]. In this dissertation, it was hypothesized that a woman will likely use a modern method if she believed she has the ability to do so (self-efficacy); has peer models and perceives support from her immediate social network (social influence); and has access to FP services in her community. More details about this theory and how it was used in this dissertation are described in Chapter Three.

A second theory explored in this dissertation is the Theory of Gender and Power. Developed by Connell in 1987 and adapted by Wingood & DiClemente in 2000, this theory postulates that three social structures (division of labor, division of power, and structure of cathexis) shape the relationship between men and women within a specific context [103-105]. The division of labor describes the allocation of jobs to women in relation to men while the division of power describes the power dynamics between men and women. The structure of cathexis, also known as the structure of affective attachment and social norms, describes what the society deems are the appropriate sexual behaviors for men and women. These three

structures together create gender inequalities that may cause adverse psychosocial and health outcomes [103-105]. Often, women bear the brunt of such inequalities. In this dissertation, it was hypothesized that gender-equitable attitudes towards: a) wife beating; b) household decisions; c) couples' FP decisions; and d) FP self-efficacy are significantly associated with modern method use over time. More details about this theory and how it was used in this dissertation are described in Chapter Four.

Current gaps in family planning research in Nigeria

Nigeria, like most of the other sub-Saharan African countries, is characterized by high fertility, of which a considerable proportion is unintended [11, 13, 106-109]. Understanding the evidence on FP in the Nigerian context is relevant to improving contraceptive use and controlling fertility. A review of the recent literature on FP use in Nigeria found that, in general, the awareness of modern methods was universal while use of those methods remained low [24-27]. This low rate of use likely contributes to the high fertility rate in Nigeria. The findings from the literature review of FP studies conducted in Nigeria indicated some of the determinants of modern method use. However, the majority of the studies did not account for the different levels of the socioecological context from which these factors may be exerting their effects. Many of the studies focused on factors within a single level of influence, usually the intrapersonal level [25, 40, 42, 49, 53, 69]. Ignoring the existence of multiple levels of influence and the interactive effects of those factors on modern method use may have led to incorrect and/or incomplete estimation of the effects of those factors. At the time of the review, only four studies examined factors on more than one level of influence using multilevel models [37, 64, 87, 110]. Two of the studies used data from the 2008 NDHS, one used data from the 2013 NDHS, while the fourth study used data from an evaluation project. Elfstrom et al. (2012) and Ejembi et al. (2015) assessed the effects of community factors, such as fertility norms, gender inequalities, poverty, and education, on use of modern methods among married women while controlling for individual factors [37, 87]. Aremu (2013) assessed the effects of individual and community socioeconomic factors on choice of FP providers among modern method users – that is whether they preferred private or public providers [110]. Gueye et al. (2015) assessed the individual and community effects of misconceived side effects of FP methods on modern method use [64]. The studies provided some information, though not exhaustive, on community determinants.

Assessing the type of statistical analysis utilized in the reviewed studies, it was found that many of the studies were descriptive [56, 57, 60, 75, 81, 111-113]; while a few others used qualitative methods [53, 54, 108]. Many of the studies were not theory-driven; only six studies stated theories that informed their research [27, 40, 69, 84, 114, 115]. Additionally, some of the reviewed studies were facility-based or school-based and focused on describing the users of certain types of modern methods, e.g., intrauterine devices, implants, and pills [56, 57, 112, 116, 117]. None of the reviewed studies assessed both the direct and indirect effects of the determinants of modern method use among reproductive-age women living in urban areas. This dissertation aimed to fill this gap in the current FP literature in Nigeria.

Family planning and urbanization

The global urban population is the highest it has ever been in history; experts estimate that more than half of the world (54%) currently lives in urban areas [118]. The urban population is projected to grow to 66% by 2050 adding an additional 2.5 billion urban residents [118]. Approximately 90% of that increase will occur in Africa and Asia. Although only about 40% of the population in Africa currently live in urban areas, it is projected that the proportion will increase to 56% by 2050 [118]. So far, urbanization in sub-Saharan Africa has been attributed to natural increase more so than internal migration [95, 119, 120]. Historically, urbanization has been linked to development [118]. However, Kessides (2006) described urbanization in Africa as both an *“opportunity as well as a management challenge”* [120]. It is an opportunity in that the concentrated human resources in urban Africa with good planning and governance can lead to physical, economic, social, and intellectual development [118, 120]. Without the commitment, especially in the context of poverty, the positive potential of urbanization will not be harnessed. Thus, there is a need for evidence-based population policies to ensure that the rapid urbanization occurring in Africa is matched with adequate resources that will lead to the achievement of the full potential for economic and health development.

Findings suggest that urban women are more empowered as they are more likely to be educated, employed outside the home, and have more access to social and health services compared to rural

women [121-123]. This urban advantage is being questioned in the context of growing urban poverty as recent evidence suggests an intra-urban disparity in access to services [95, 96]. Studies show that the urban poor in sub-Saharan Africa have more social and health disadvantages compared to their wealthier counterparts and, in some cases, even the rural residents [95, 96, 119, 124]. Physical proximity to services does not guarantee access for the urban poor. It is hypothesized that since urban residents depend on cash income for all services, a limited or lack of income results in immediate consequences such as inability to afford health services [120]. A 2003 study that used Demographic and Health Surveys (DHS) from 23 countries in sub-Saharan Africa found that poverty (defined as lack of access to electricity, piped water, and flush toilet) created an intra-urban health disparity in access to maternal care; urban poor women had limited access to antenatal and delivery care compared to their wealthier counterparts [96]. Ezeh et al. (2010) found that the level of modern method use among the poorest urban married women was close to and in some cases less than that of the rural married women in sub-Saharan Africa [95]. The implication of these findings is that the urban advantage probably applies only to the urban rich. Thus, the concept of '*urban penalty*' applies to the urban poor who are experiencing worse social and health outcomes compared to the urban rich and rural residents. Sub-Saharan African countries, including Nigeria, need to prepare for the postulated high rates of urban growth and the expected poverty by ensuring that adequate resources will be available and accessible. Understanding ways of ensuring universal access to health services including FP services in urban areas is critical.

Nigeria is one of the three countries that will account for over a third of the postulated urban growth by 2050; the other two countries are China and India [118]. In 1950, only 8% of Nigeria's population lived in urban areas; currently, 48% of the population live in urban areas and it is projected that by 2050 the proportion will increase to 67% adding 212 million urban residents between 2014 and 2050 [118]. The capital city, Abuja, is one of the top ten fastest growing cities in the world, growing at a rate of 7% annually [118]. The estimated urban growth rate in Nigeria for 2015-2030 (the SDG era) is about 4% [118]. This rate, coupled with the fact that Nigeria is the most populous country in Africa, is of great concern. It is estimated that about 80% of urban residents in Nigeria live in slums [24, 119, 125]. Slums are often defined as informal settlements with insecure land tenure, poor quality housing, high population

density, and little/no access to basic services [119]. There is a dire need to manage the urban growth rate in Nigeria and to develop programs and policies for slum upgrading, which will include, but not limited to, increasing access to basic amenities.

The current urban total fertility rate is high at about 4.7 children per woman [23, 24] and it has been reported that about one-quarter of pregnancies in Nigeria are mistimed or unwanted [13]. Since it is natural increase rather than internal migration that is the major driver of the urban population growth in Nigeria, ensuring adequate access to and use of FP services is likely to contribute to the reduction of unintended pregnancies, which may help in controlling urban population growth. Research has shown that many urban women in Nigeria have high knowledge of contraceptive methods, want to delay pregnancy for at least two years, but are not using a contraceptive method [23, 24]. There seem to be numerous barriers to use of modern methods in these urban settings. Improving FP in urban areas in Nigeria will not only benefit the urban residents but is likely to benefit the rural residents as well through diffusion of contraceptive knowledge and behavior. In light of the high urbanization rate and the need to understand the urban context, this dissertation focused on filling the gap in the current FP literature in urban Nigeria. The research aims, estimation methods, and findings of this dissertation are discussed in the subsequent chapters. The final chapter highlights the implications of this study providing evidence for strategies to help Nigeria attain their FP targets.

CHAPTER 2: RESEARCH STRATEGY

Study Setting

This dissertation used data obtained from six cities in Nigeria. Nigeria is a West African country located on the Gulf of Guinea with a total area of 923,768 square kilometers making it the 14th largest country in Africa and the 32nd largest country in the world [126]. Nigeria is bordered on the west by the Republic of Benin, on the east by Cameroon and Chad, on the north by Niger, and on the south by the Gulf of Guinea as shown in *Figure 2.1* [127]. Laying in the tropics with varied landscapes, the southern region is characterized mainly by rainforest vegetation and mangrove swamps while the northern region is made up of savannah vegetation [128]. There are two weather seasons in Nigeria: a rainy season and

Figure 2.1: Administrative Map of Nigeria

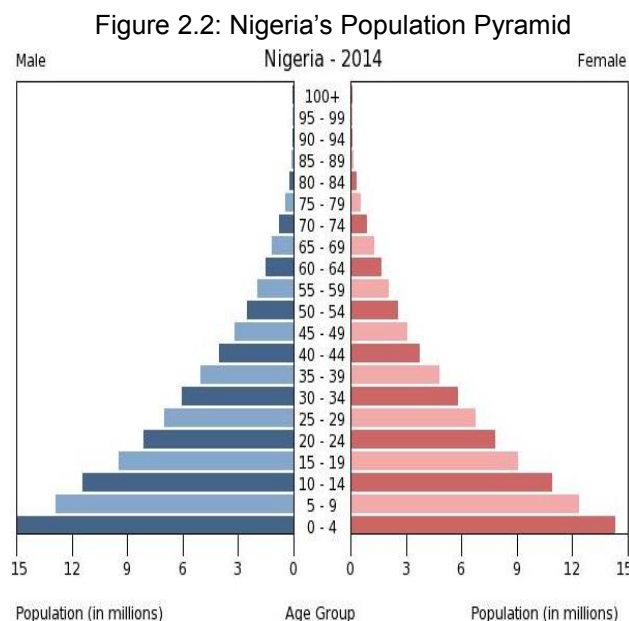


a dry season. The rainy season begins in March and ends in October while the dry season starts in November with a Harmattan season characterized by dust haze and dryness but becomes milder between February and April [129]. There is a wealth of natural resources in Nigeria including petroleum, natural gas, coal, gold, tin, iron ore, limestone, niobium, lead, and zinc [130]. Petroleum is the most produced as Nigeria has the tenth largest proven reserves, is the

twelfth largest producer, and the eighth largest exporter of petroleum in the world [130]. Prior to the discovery of petroleum in 1956, agriculture was the main focus with cocoa and rubber being the main foreign exchange products [126, 130]. About 78% of land use is for agricultural purposes; however, Nigeria currently faces rapid deforestation, soil degradation, and urban air and water pollution [126].

Nigeria obtained her independence from the British colonization on October 1, 1960 [126]. As a Federal Republic, there are three tiers of government: federal, state, and local government. Currently, there are 36 states and one Federal Capital Territory (Abuja) grouped into six geo-political zones: north-west, north-central, north-east, south-west, south-east, and south-south zones. The states are subdivided into 774 Local Government Areas (LGA) [131]. Each state is headed by a governor while each LGA is led by a LGA council consisting of a chairman and a board of councilors. There are two major religions in Nigeria, Islam and Christianity. The Muslims are predominantly located in the northern region while the Christians are mainly in the southern region. It is estimated that Nigeria has about 250 tribes with the top three tribes being Hausa, Yoruba, and Igbo, geographically located in the North, West, and South, respectively [23, 126]. Although there are about 500 indigenous languages and dialects, English is the official language; Hausa, Yoruba, and Igbo languages are the commonly spoken local languages.

With a 2015 estimated population of 182 million people, Nigeria is currently the most populous country in Africa and the seventh most populous country in the world [132]. With an annual population growth rate of 2.5%, it is projected that Nigeria will become the fourth most populated country in world by



2050, reaching a population of almost 400 million people [118, 126, 132]. Presently, Nigeria has a young population with 43% aged 0-14 years and 19% aged 15-24; one-third of the population is aged between 25 and 64 years giving a total dependency ratio of 88% [126]. The population pyramid is shown in *Figure 2.2*. The median age is 18 years for both men and women and the gender ratio (male to female) is 1:1. There are about 35 million reproductive-age women in Nigeria [23]. The World Bank classifies Nigeria as

a lower middle-income country based on the 2014 gross national income per capita of \$2,950 US Dollars [133]. Nigeria currently has the largest economy in Africa with an estimated 2014 gross domestic product

(GDP) of \$568.5 billion US Dollars and an annual growth of 6.3% [133]. The revenues are mostly from petroleum, agriculture, and telecommunications. Despite the economic growth, the World Bank estimates that 62% of Nigeria's population live in extreme poverty ($\leq$ \$1.25 per day) [133]. The rate of unemployment is estimated at 24% with many young people migrating to urban areas for economic opportunities. In 2013, only about 4% of Nigeria's GDP was spent on health, a decline from the 12% in 2003 [126, 131].

Healthcare in Nigeria is delivered through the public and private health sectors. Healthcare is delivered through the public sector simultaneously by the three tiers of government: the primary health centers are managed by the Local Government Health Authority, the secondary health facilities (general hospitals and medical centers) are managed by the State Ministry of Health, while the tertiary health facilities (university teaching hospitals and federal medical centers) are managed by the Federal Ministry of Health [131]. The private-sector health facilities are owned by individuals, faith-based organizations, and other NGO. The National Health Insurance Scheme was created in 1999 and covers government employees and organized private-sector institutions; however, many of the citizens are not covered and have to pay out-of-pocket for medical expenses [23, 131]. According to the 2013 NDHS, only 2% of reproductive-age women (15-49 years) had health insurance [23]. Since the public-sector primary and secondary health delivery systems are managed by the local and state governments, the availability and quality of health services at these tiers of government are dependent on the level of priority they place on health. Expectedly, there are geographic inequalities in access to health services [131]. For instance, less than 1% of primary health centers in the north-west zone provide immunization services compared to over 90% in south-west and south-east zones [131]. The average life expectancy at birth is 52 years with an infant mortality rate of 69 per 1,000 live births and a MMR of 814 deaths per 100,000 live births [2, 126, 132]. These rates are higher than the averages for the sub-Saharan African region [132]. In 2013, Nigeria contributed the most to the global human immunodeficiency virus (HIV) related deaths and had the third largest absolute number of people living with HIV globally; the HIV prevalence among adults is currently at 3% [126]. The current CPR is 15% while the unmet need for FP is 16% [23].

The data for this dissertation were collected from these six cities briefly discussed below:

- Abuja. As the capital city, Abuja is the first planned city in Nigeria. It was built in the 1980s and was conveniently situated at the center of the country to neutralize the ethnic, religious, and geographic divide. Abuja is located in the north-central zone and covers a landmass of 7,754 square kilometers [134]. It became the capital of Nigeria in 1991 replacing Lagos, which is now considered the commercial capital of Nigeria [126]. There are five LGAs in Abuja. The population of Abuja during the 2006 national census was 1.4 million [134]. However, the 2015 estimated population is 2.4 million people making it the fourth most populated city in the Nigeria [135]. The urban population growth rate is currently at 7% per annum [118]. According to the 2013 NDHS, the total fertility rate in Abuja was 4.5 children per woman, while the CPR and unmet need for FP were 25% and 20%, respectively [23]. The childhood vaccination rate was 61% while childhood stunting was 21%. Additionally, about 56% of women and 73% of men were employed [23]. Abuja has a diverse cultural background owing to the influx of people from different parts of the country since it became the capital city. This influx has led to the emergence of informal settlements in the outskirts of the city.

- Benin. Benin is the capital of Edo state, which is one of the six states located in the south-south zone of Nigeria [134]. Edo state has a landmass area of 19,819 kilometer square and a 2006 population of 3.2 million [134]. It is estimated that the population of Benin is currently at 1.5 million people (30% of the population of Edo state) making it the sixth most populated city in Nigeria [135]. Edo state is known for its rich cultural and art history and is famous for its bronze and ivory sculptures [134]. The Benin Empire was one of the most powerful African empires during the 15th and 16th centuries with Benin being the seat of government at the time. There are 18 LGAs in Edo state [134]. The predominant religion in the state is Christianity with a small proportion practicing the indigenous religion. In 2013, the total fertility rate in Edo state was 4.5 children per woman, while the CPR and unmet need for FP were 30% and 19%, respectively [23]. About 62% of women and 71% of men were employed [23]. Regarding child health in Edo state, 52% of children aged 12-23 months had been vaccinated while 16% of children under 5 years of age were too short for age (stunting) in 2013 [23].

- Ibadan. Ibadan is the capital of Oyo state, which is located in the south-west zone [134]. Oyo state has a landmass area of 28,245 kilometers square and a population of 5.6 million [134]. With a 2015 population of 3.1 million people, Ibadan is the third most populated city in Nigeria [135]. The people

of Oyo state are of the Yoruba tribe and are both Christians and Muslims with a small proportion practicing indigenous religion. There are 33 LGAs in Oyo state and in 2013, about 78% of both the women and men were employed [23, 134]. Regarding child health in Oyo state, the 2013 NDHS found that 27% of children under 5 years of age were stunted while only 26% of children aged 12-23 were vaccinated [23]. The total fertility rate in Oyo state was 4.5 children per woman in 2013, while the CPR and unmet need for FP were 30% and 19%, respectively [23].

- Ilorin. Ilorin is the capital of Kwara state, which is located in the north-central zone [134]. With a population of 899,000 people, Ilorin is the 13th most populated city in Nigeria [135]. Kwara state has a landmass area of 34,468 kilometer square and a population of 2.3 million [134]. The people of Kwara state are mainly of the Yoruba tribe with a mix of Muslims and Christians. There are 16 LGAs in Kwara state and about 63% of women and 73% of men were employed in 2013 [23]. The childhood vaccination coverage at the state level was 27% while stunting was 43% in 2013 [23]. The total fertility rate was 5.1 children per woman, the CPR was 40% while the unmet need for FP was 12% in 2013 [23].

- Kaduna and Zaria. Kaduna is the capital of Kaduna state, which is located in the north-west zone [134]. The population of Kaduna city was 760,000 during the 2006 census but has grown to over 1 million people by 2015, making it the ninth most populated city in Nigeria [135]. Kaduna is a commercial city with a diverse group of people from different ethnicities; as such, there is a mix of religions in the city often leading to religious strife [126, 133]. Also located in Kaduna state is Zaria, which has a population of 1 million people as well. Zaria is the capital of the Hausa kingdom of Zazzau and is the eighth most populated city in Nigeria. The main religion in Zaria is Islam. Zaria is home to Ahmadu Bello University, the largest university in Nigeria and the second largest on the African continent. Kaduna state has a landmass area of 45,711 kilometer square and a population of 6.1 million [135]. There are 23 LGAs in Kaduna state. The people of Kaduna state are mainly of the Hausa tribe and speak mainly the Hausa language, although English is the official language. In addition to the customary and common law, Sharia law is upheld in Kaduna state. About 61% of women and 76% of men in Kaduna State were employed in 2013 [23]. At the state level, the total fertility rate was 4.1 children per woman, the CPR was 20%, while the unmet need for FP was 6% [23]. The childhood vaccination coverage was 35% while the prevalence of stunting among children under 5 years of age was 57% in Kaduna state in 2013 [23].

Specific Aims

The goal of this dissertation was to assess factors associated with modern method use among reproductive-age women in urban Nigeria. This research was guided by the Socioecological Framework; multilevel models were used to estimate the effects of the determinants of FP on modern method use in among the study sample. The two specific aims in this dissertation are described briefly in this Chapter but in more detail in Chapters Three and Four where they are presented in manuscript formats.

Specific Aim 1: To determine the effects of intrapersonal, interpersonal, institutional, community, and societal factors on use of modern methods among women aged 15-49 living in six cities in Nigeria.

Theory: This study's hypotheses were informed by the Social Cognitive Theory [65].

Hypothesis 1.1: Intrapersonal and interpersonal (individual-level) factors are significantly associated with modern method use;

Hypothesis 1.2: Controlling for individual-level factors, institutional, community, and societal (community-level) factors are significantly associated with modern method use; and

Hypothesis 1.3: Additionally, cross-level interactions between community-level and individual-level factors are significantly associated with modern method use. Specifically,

Hypothesis 1.3.1: The association between individual-level parity and modern method use is moderated by living in a community with large family size norm.

Hypothesis 1.3.2: The association between individual-level employment and modern method use is moderated by living in a poor community.

The study, informed by the Social Cognitive Theory, went beyond the traditional single-level analysis to use multilevel models ensuring that the multiple levels of influence of the socioecological system were accounted for. Single-level analyses of clustered samples provide biased estimates as they do not account for the hierarchical structure of data [136]. The use of multilevel models for the analysis of this specific aim provided robust information that was not obtainable in the current literature. Multilevel models: a) correct for clustering effects providing unbiased estimates; b) correct for non-independence of observations providing accurate standard errors, confidence intervals, and significance tests; and c)

estimate variance and covariance at various levels allowing for partitioning of the effects of the different levels on the outcome [136]. The focus of this study on urban women was unique in that it provided in-depth information on how the characteristics of an urban community influence contraceptive behavior. Prior studies often compare urban to rural areas [27, 35, 37, 44, 87, 94]. Urban areas are different in ways that are incomparable to rural areas, e.g., population density and pockets of poverty in the midst of wealth. Hence, the traditional rural-urban comparisons mask the effect of urbanization on health. There is a need for urban-focused research to assess how the peculiar features of an urban community influence urban fertility and contraceptive behaviors. Looking specifically at FP studies conducted in Nigeria as reviewed in Chapter One, it was observed that many of the studies were descriptive and not driven by theory. Many of the studies were single-level analyses despite the fact that their aim and the structure of their data warranted a multilevel approach [11, 42, 137, 138]. This dissertation is innovative in its use of data from multiple sources collected via rigorous study designs and in its use of multilevel models to explore, not only intrapersonal factors, but also interpersonal, institutional, community and societal factors that may influence the use of modern methods among reproductive-age women in select cities in Nigeria. Till date, no study has examined this collective set of level-specific exposure variables.

Specific Aim 2: To determine the effects of changes in the levels of individual and community gender-equitable norms on changes in the use of modern methods over time among women aged 15-49 living in six cities in Nigeria.

Theory: The study hypotheses were informed by the Theory of Gender and Power [103].

Hypothesis 2.1: Positive changes in gender-equitable norms at the individual-level will increase the probability of modern method use and adoption over time; and

Hypothesis 2.2: Controlling for the changes in gender-equitable norms at the individual-level, living in communities with positive changes in the level of gender-equitable norms will increase the probability of modern method use and adoption over time.

This study, informed by the Theory of Gender and Power, examined the effects of gender-equitable norms on modern method use in urban settings. Urban populations are usually made up of

people from diverse backgrounds and cultures. Therefore, it is expected that the role gender norms play in an urban setting with diverse populations may be different from that in a rural area, which usually have a more homogenous population. The norms examined in this study included gender-equitable attitudes towards: a) wife beating; b) household decisions; c) couples' FP decisions; and d) FP self-efficacy. The inclusion of multiple measures of gender norms accounted for a comprehensive view of their effects on modern method use. According to the High-level Task Force for ICPD beyond 2014, violence against women controls women's autonomy and sexual and reproductive health choices and has grave consequences such as unwanted pregnancies and unsafe abortions [139]. It is possible that the health consequences of gender-based violence are not limited to women who experience such violence but may also apply to women who believe that such violence is permissible. This study is innovative in its use of longitudinal data to examine the effects of the gender-equitable norms on modern method use over time.

The revival of attention on reproductive health as a means of achieving global development and sustainability has placed a lot of emphasis on the importance of universal access to quality reproductive health services including FP services [1]. This attention has also informed several research and program activities to identify ways of improving use of FP services especially among vulnerable populations. The literature on the determinants of modern method use is robust as discussed in Chapter One. However, gaps still exist in the literature especially on issues around the interplay between the physical and social environments and how they influence contraceptive behaviors. This dissertation contributed to filling that gap by using multilevel models, informed by the Socioecological Framework, to assess the simultaneous effects of individual and community factors on the contraceptive behaviors of a longitudinal sample of urban women in Nigeria. To the best of my knowledge, this is the first study of contraceptive behaviors of a strictly urban sample from multiple cities representing both the northern and southern regions of Nigeria. Evidence from this dissertation is relevant to urban reproductive health policy and practice.

Study Design and Data Collection Strategies

The data used in this dissertation were collected by the Measurement, Learning & Evaluation (MLE) Project in Nigeria between 2010 and 2014 for the purposes of evaluating a FP program – the

Nigerian Urban Reproductive Health Initiative (NURHI). NURHI was part of a multi-country multi-strategy FP program, the Urban Reproductive Health Initiative, funded by the Bill & Melinda Gates Foundation and implemented in select urban areas of four countries: Nigeria, Kenya, Senegal, and India [140]. NURHI, a five-year program, aimed to increase the use of modern methods in six purposively-selected cities: Abuja, Benin, Ibadan, Ilorin, Kaduna, and Zaria. The key strategies implemented by NURHI were: strengthening FP service delivery in both public and private health facilities; generating demand for FP services through community engagement and multimedia campaigns; building a supportive environment for FP through advocacy; and use of monitoring and evaluation data to improve program activities. Information about NURHI can be found on their website [<http://www.nurhitoolkit.org>]. The MLE Project, the independent evaluator of NURHI, is housed at the Carolina Population Center, University of North Carolina at Chapel Hill. The overall goal of the MLE project in Nigeria was to identify which NURHI interventions were most effective in improving modern method use and how they can be scaled up to other regions of the country. The MLE Project used rigorous study designs, multiple data collection strategies, and complex impact evaluation statistical methods in the evaluation of NURHI. Prior to the start of the NURHI program, baseline information were collected between 2010 and 2011 to provide pre-program information and inform program targets. Endline data were collected in 2014 to measure the impact of the program.

As shown in *Figure 2.1* and discussed above, Nigeria is divided into states, which are subdivided into LGAs; the LGAs are further divided into localities [126, 131]. At the most recent national census (2006), each locality was subdivided into convenient enumeration areas. Cities are often made up of parts of multiple localities but are confined within specific states. In other words, the boundaries of a city does not cross state borders but may include multiple localities. The MLE Project utilized a two-stage cluster sampling design for data collection. The sampling design is described in more details in Chapters Three and Four with respect to the data used in assessing the two specific aims of this dissertation; a summary is provided here. The 2006 census enumeration areas were used as the primary sampling units and are hereafter referred to as clusters. Only urban clusters were included in the sampling frame. For the first stage of the sampling design, a simple random sample of urban clusters was selected within each city. Then for the second stage, a random sample of households (for the household-based surveys) and a

census of public health facilities together with a convenience sample of private health facilities (for the facility-based surveys) were selected. For the baseline household-based survey, reproductive-age women (ages 15-49) and men (ages 15-59) who resided in the selected households were eligible for study participation. The facility-based surveys consisted of facility audits, provider surveys, and exit client interviews. The women's and facility audit surveys were longitudinal surveys while the others were repeated cross-sectional surveys.

Ethical approval

The protocols and procedures used by the MLE Project were approved by the Nigeria Health and Research Ethics Committee and the Institutional Review Board at the University of North Carolina at Chapel Hill. Informed verbal consent was obtained from every respondent prior to study participation.

Statistical Approach

Multilevel models were used to statistically estimate the effects of individual-level and community-level factors on modern method use. Multilevel models were first used by sociologists in the field of education to understand the effects of teachers', classrooms', or schools' characteristics on academic achievement of the students [136, 141]. Since then, the use of multilevel models has extended into other fields including public health. The traditional multivariate regression models estimate the associations between a set of exposure variables and an outcome measure at a single level, usually the individual level. These regression models make several assumptions: a) normal distribution of variables; b) normal distribution of residuals; c) residuals have a constant variance σ^2 ; d) the observations are unique and independent of each other; and e) exposure variables have linear relationships with the outcome variable [136, 141, 142]. These assumptions need to be met for the estimated effects and associations to be unbiased and reliable. However, in reality, some of these assumptions are often violated at some point during the data collection, analysis, or interpretation of results. Most surveys, for many reasons, use a clustered study design for data collection; for example, household-based surveys have individuals clustered within households, which are clustered within communities and localities. This clustering of observations violates the assumption of independence as individuals within a group have similar

characteristics and are no longer providing unique information, thus reducing the effective sample size. Clustering affects the sampling variance; this effect is called the design effect. Hox (1998) described this design effect as the ratio of the operating sampling variance to the sampling variance under the assumption of simple random sampling [141]. A design effect of 1 means that clustering is not an issue; however, a design effect greater than 1 indicates the need to account for clustering in the data analysis. Ignoring the hierarchical structure of the clustered data can lead to biased results and inferences due to increased Type 1 error [136, 141]. In such situations, the use of multilevel models becomes relevant.

Multilevel modeling is particularly important when the data used in studying an outcome measure were collected using a clustered study design and there is an interest in examining the levels at which different factors exert their influence on the outcome measure [136, 141]. In addition, multilevel models allow the partitioning of the total variation in the outcome measure into proportions due to differences between individuals and that due to differences between groups [136, 141]. This is especially important in public health where it may be essential to know the appropriate level to implement an intervention to achieve the most desired effect. In multilevel modeling, the outcome variable is usually measured at the lowest level while the exposure variables are measured at all existing levels. Multilevel models do not assume independence of observations and/or residuals; however, other assumptions are made [136, 141]. First, it is assumed that residuals at the lowest level have a normal distribution with a mean of zero and a common variance (σ^2) in all groups. The residuals at the group level are assumed to have a multivariate normal distribution and are not correlated with the residuals at the individual level. Just like in other regression models, the linearity assumption is also made (i.e. exposure variables have linear relationships with the outcome variable). However, models can be extended to accommodate different types of outcome measures. For instance, the logit link function is used to extend the linearity assumption if the outcome measure is binary [136]. The advantages of using multilevel models include, but are not limited to: a) provide a framework for studying hierarchical data resulting in a simultaneous analysis of direct and indirect effects of factors that exist on multiple levels of influence on the outcome of interest; b) correct for clustering resulting in more accurate estimates and inferences; and c) allow the decomposition of the total variance in the outcome variable into portions associated with each level of influence [142].

Multilevel models are estimated in steps [136, 142]. The first model estimates the unconditional or intercept-only (null) model with no exposure variables. The estimates from this null model are used to assess the extent to which the outcome variable varies across clusters. The null model provides estimates of the within-cluster and between-cluster variances and serves as the base model to which the conditional models are compared. The second step estimates the individual-only model with only the individual exposure variables. The between-cluster variance of this model is compared to that of the null model to estimate the proportion of the between-cluster variance explained by the individual factors. The third model includes the individual and community exposure variables and produces the simultaneous effects of individual and community factors on the outcome variable. This model is compared to the null model to estimate the proportional change in the between-cluster variance explained by both the individual and community factors. If the moderating effects on the community factors on the individual factors is needed, then a fourth model estimating the cross-level interaction effect is estimated.

The multilevel models estimate the fixed effects and the random effects on the outcome variable and is sometimes referred to as mixed models. The multilevel models provide information on the intra-cluster correlation coefficient (ICC), which describes how individuals in the same cluster are similar to each other compared to individuals in different cluster [136, 141, 142]. In linear multilevel models, the ICC provides information on the proportion of total variance in the outcome that is attributable to the cluster level because both the individual and cluster level variance are estimated and are on the same scale [142]. However, this is not the case in multilevel logit models where the individual level is on a probability scale and the group level is on a logistic scale; thus, the interpretation of the ICC is not intuitive. Alternative methods that convert both levels to the same scale are proposed. One such method is the linear threshold model method, which converts the individual level from a probability scale to a logistic scale by assuming that the individual-level variance in a multilevel logit model is a constant ($\pi^2/3 \approx 3.29$). With this conversion, the ICC can be interpreted. In addition to ICC, the estimates from the multilevel model can be used to calculate the Median Odds Ratio (MOR); the MOR, quantifies the cluster-level variance in terms of odds ratio, allowing direct comparison of the estimated cluster effect to the estimated

fixed effects of the exposure variables in the model [142]. For example, if the MOR of the fully adjusted model of modern method use is 1.50 and the fixed effect of being employed (an individual factor from the same model) is 1.20, then it can be inferred that, compared to being employed, cluster membership has a greater effect on the odds of modern method use. The ICC and MOR provide unique information on the effect of contextual factors on individual outcomes. Goodness-of-fit tests are conducted post-estimation to ensure the multilevel models fit the data appropriately [136].

In this dissertation, the fixed effects of the exposure variables existing on multiple socioecological levels and the random effects at the cluster level were estimated using multilevel models. All analyses were run using a user-written Stata command '*gllamm*' that estimates Generalized Linear Latent and Mixed Models (GLLAMM) [143-145]. GLLAMM are a class of multilevel models that estimates different types of outcome variables including, but not limited to, continuous, binary, and count variables. GLLAMM allow for conditional distribution of the outcome variable to be specified through a family and a link function given the exposure variables and random effects [144]. Because of the binary outcome variable for the first study, a 'logit' link function and a 'binomial' family function were specified. An 'mlogit' link function and 'binomial' family function were specified for the second study because of the categorical outcome variable. The random effects estimators are maximum likelihood estimators, which under model assumptions, produce consistent and asymptotically efficient estimates [144, 146]. Sometimes, it is difficult to test whether the model assumption about the distribution of the residuals was met. To avoid biased estimates due to unknown violation of assumption, the discrete factor approximation method was used as it produces semi-parametric estimators that do not make any distributional assumption about the residuals but instead estimate optimal mass points and weights that approximate the true distribution of the residuals [146]. Wald tests were used to determine the statistical significance of the estimates, which were reported as odds ratios (OR) together with their 95% confidence intervals (CI). Goodness-of-fit tests were conducted post-model estimation to assess the fit of the multilevel models. The tests included: a) Likelihood Ratio (LR) tests; b) Chi-square tests; and c) Akaike information criterion (AIC). Details specific to the two studies (specific aims) included in this dissertation are included in Chapters Three and Four.

CHAPTER 3: A MULTILEVEL LOGIT ESTIMATION OF FACTORS ASSOCIATED WITH MODERN CONTRACEPTION IN URBAN NIGERIA

Overview

Objective: About one in five maternal deaths that occurred worldwide in 2015 happened in Nigeria – a West African country with the highest population in Africa. Maternal deaths can be prevented through the prevention of unintended and high-risk pregnancies. About a quarter of all pregnancies in Nigeria are unintended at the time of conception. Despite this high rate of unintended pregnancy, the proportion of reproductive-age women using effective contraceptive methods remains low. This study aimed to estimate the individual and community level determinants of modern method use in urban Nigeria.

Methods: This study was conceptualized using the Socioecological Framework. Data from multiple cross-sectional surveys conducted between 2010 and 2011 were linked to provide information on the five hierarchical levels of the framework. Multilevel logit models were used to estimate the probability of using a modern method among 15,947 women aged 15-49 years living in six purposively-selected cities [Abuja, Benin, Ibadan, Ilorin, Kaduna, and Zaria].

Results: About 21% of the women were using a modern method at the time of survey. Estimating the multilevel effects of the socioecological factors explained 60-88% of the variance in the use of modern methods during the study period. Statistically significant associations were found between modern method use and factors at the intrapersonal, interpersonal, community and societal socioecological levels ($p < 0.05$). Significant modifying effects of community factors on the association between individual factors and modern method use were also observed ($p < 0.05$).

Conclusion: Evidence from this study indicates the need for multi-level interventions as a way to improve the prevalence of modern method use in urban Nigeria. The design, implementation, and evaluation of such interventions should be tailored to the specific characteristics of the community.

Keywords: Modern Contraception; Multilevel Models; Socioecological Framework

Background

Currently, a reproductive-age woman in Nigeria – a West African country – will have on average 5.5 children during her lifetime [23]. According to the 2015 World Population Data, Nigeria is currently the most populous country in Africa with a population of 182 million people [132]. With an annual population growth rate of about 3%, demographers postulate that Nigeria's population will rise to 400 million making it the fourth most populous country by 2050 [132, 24]. Currently, about one-half of Nigeria's population lives in urban areas [118]. Urbanization in Nigeria is said to be driven by high fertility more so than rural-to-urban migration and according to the United Nations, over two-thirds of urban residents live in slums [119]. Although evidence suggests that urban women are more likely to use modern methods compared to their rural counterparts, recent studies find that this urban advantage may be misleading given low levels of contraceptive use among the urban poor. Within urban settings, the poor have been shown to have more social and health disadvantages compared to their wealthier counterparts and, in some cases, compared to those living in rural areas [95, 96]. For instance, in several sub-Saharan African countries, including Nigeria, Magadi et al. (2003) found that the urban poor experienced more adverse maternal health outcomes compared to the urban rich [96]. Ezeh et al. (2010) also found that the level of modern method use among the poorest married women in urban areas was close to or less than that of the married women in rural areas [95]. The urban population in Nigeria is expected to triple by 2050 – making it the third largest absolute increase in urban population globally, after China and India [118]. To curb the rapid urban growth in Nigeria, there is a need to improve access to and use of modern contraception.

FP improves maternal and child health through prevention of unwanted pregnancies and prolongation of the inter-pregnancy interval, increased women's empowerment through education and engagement in the workforce, and environmental sustainability through population control [9, 10, 20]. Despite these benefits, not all women who want to avoid getting pregnant use effective contraceptive methods. The modern contraceptive prevalence rate (MCPR), defined as the percentage of reproductive-age women (ages 15-49) who are using a modern method at a specified time, is a commonly used indicator for assessing FP use at the population level [21]. Several correlates of modern method use have been described in the reproductive health literature [17, 31]. However, gaps exist in the current literature.

One such gap is on the contextual determinants of modern method use. Many studies focus on the effects of individual-level factors (e.g. age, education, and parity) on the probability of using modern methods; only a few studies examine the effect of the household and/or community factors [37, 38]. A more comprehensive view of the determinants of modern method use is needed. Most of the prior studies only control for urban residence in their analysis; this type of analysis ignores the potential for an urban penalty for the poor, as the effect of the urban rich often masks that of the urban poor giving a false impression of an urban advantage. Therefore, the importance of an in-depth analysis of the urban FP situation is underscored in light of the high urbanization rate and urban poverty. This study aimed to fill these gaps by answering the following research questions?

- (1) Are individual-level factors associated with modern method use among reproductive-age women (ages 15-49) living in six cities in Nigeria?
- (2) Controlling for individual-level factors, are community-level factors associated with modern method use among these women?
- (3) Do community-level factors modify the association between individual-level factors and modern method use among these women?

Conceptual framework and theory

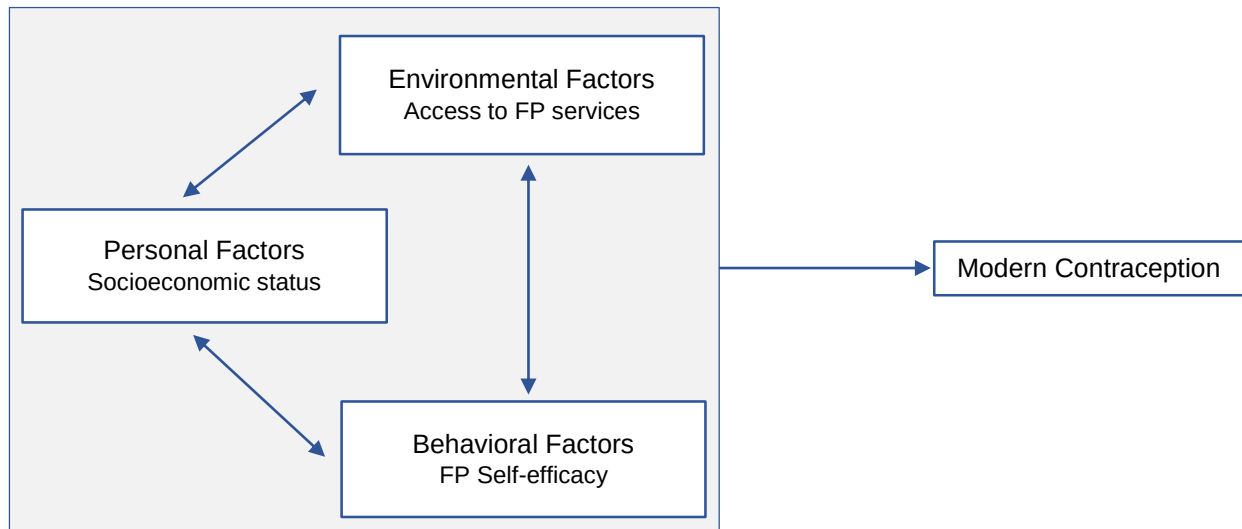
This study used the Socioecological Framework to conceptualize the multiple levels of influence on modern method use. The framework was developed by Bronfenbrenner in the 1970s and describes the complex relationships between individuals and their physical and social environments [45, 46]. An adapted version of the framework that models the determinants of a health behavior was developed by McLeroy and colleagues in 1988; they classified the behavioral determinants into five hierarchical levels of influence: intrapersonal, interpersonal, institutional, community, and societal levels [47]. These levels are nested within each other and are hypothesized to interact to have an effect on a behavioral outcome. In this study, the behavior of interest is modern method use. The intrapersonal level includes the characteristics of the woman such as her age, education, religion, marital status, wealth, parity, and FP self-efficacy. The interpersonal level includes factors that reflect the woman's interactions with people within her immediate social network such as her male partner or other women in her neighborhood.

These interpersonal interactions have been shown to influence the woman's probability of practicing contraception [44, 36]. The factors that exist at the institutional level include the availability of FP services in the health institutions accessible to the woman. A recent study in Nigeria found that women who reported having access to health facilities within their communities had higher probability of modern method use [87]. Factors that exist within a defined boundary of the woman's residence were included at the community level; for example, studies have found that the neighborhood poverty level and/or norms about desired family size influence the odds of modern method use among reproductive-age women [37]. The FP policies and programs that exist at the local, state, and/or federal government influence access to FP services at the societal level and, thus, affect the probability of modern method use [97]. In order to adequately measure the determinants of modern method use, there is a need to account for the direct and interaction effects of the factors that exist on these multiple socioecological levels.

Although there are multiple behavioral theories that explain the interactions between the factors that exist within the Socioecological Framework, the Social Cognitive Theory was used in this study. The theory was developed by Albert Bandura and posits that the dynamic interaction between individuals' personal factors (also known as cognitive factors), behavioral factors, and environmental factors results in the development and/or adoption of behaviors as represented in *Figure 3.1* [101, 102, 147]. A key construct of this theory, reciprocal determinism, postulates that the behavioral, environmental, and personal factors are continuously influencing and being influenced by each other [147]. In this study, the key behavioral factor assessed was *self-efficacy towards FP use*; this construct measures the woman's belief in her ability to use a modern method if and when she wants to [147]. This self-efficacy is, in turn, expected to increase her likelihood of using a modern method. The personal factors included in this study are the women's socioeconomic status. The socioeconomic factors examined were educational level and household wealth. The environmental factor included in this study is the women's access to FP services; it is postulated that having access to health services increases the probability of adopting healthy behaviors [147]. Thus, women who live in communities with FP services are hypothesized to have increased probability of using modern methods. Hence, to adequately measure the determinants of modern method use in this study, there is a need to account for both the direct and cross-level interaction

effects of the socioecological factors. The interaction between the environmental factors that exist at a higher level and the personal and behaviors factors that exist at the individual level were estimated.

Figure 3.1: The Social Cognitive Theory



Methods

Study design

This study used de-identified cross-sectional data collected in Nigeria by the Measurement, Learning & Evaluation (MLE) Project. The MLE Project is the evaluation arm of the Urban Reproductive Health Initiative, a multi-country FP program implemented in select cities in four developing countries: India, Kenya, Senegal, and Nigeria [140]. The program in Nigeria – Nigerian Urban Reproductive Health Initiative (NURHI) – aimed to reduce the barriers to modern method use. To evaluate NURHI, the MLE project conducted multiple surveys over a period of five years. This study used data from baseline surveys: women's survey, facility audits, and service provider survey. These surveys were conducted in six cities purposively-selected by the NURHI program: Abuja, Benin, Ibadan, Ilorin, Kaduna, and Zaria. These cities are located in the northern and southern regions of the country.

Women's Survey. A two-stage cluster sampling design was used to select a representative sample of reproductive-age women in each city. A sampling frame based on the 2006 census in Nigeria

was used to select a sample of enumeration areas. Enumeration areas are subdivisions of localities; localities are the smallest administrative units. These enumeration areas were used as the primary sampling units and are hereafter termed clusters. In the first stage of sampling, a random sample of urban clusters was selected in each city. The number of clusters selected ranged from 74 in Zaria to 102 in Ibadan resulting in a total of 491 clusters across all cities. For the second stage of sampling, a random sample of about 41 households was selected within each cluster. Women aged 15-49 who resided in selected households or were visitors present on the night before the survey were eligible to be interviewed. Following informed consent, the women were interviewed by trained female interviewers using paper-and-pencil questionnaires at private locations within or close to their residence. A total of 16,144 women completed the survey (95% response rate). The women's survey was conducted between October 2010 and April 2011. Detailed information about this survey is published elsewhere [148].

Facility-based Surveys. The facility surveys were conducted between February and June 2011 in three facility types: health facilities, pharmacies, and drug stores. A list of facilities in the target cities was obtained from relevant agencies such as the Federal and State Ministries of Health. This list was updated during a verification process by visiting all listed facilities and confirming they were open for business. The geographic information system (GIS) points of all verified facilities were collected using global positioning system devices. A master file of the verified facilities was used as the sampling frame.

- Health facility audit & service provider survey: During the verification process, information was obtained on whether the health facility provided maternal, neonatal, and child health (MNCH) services and the antenatal care client load. The health facilities were classified as high-volume if they provided MNCH services and had a client load of more than 1,000 antenatal care patients per year. In addition, during the women's survey, the women were asked to name the facilities they go to for MNCH services. The most frequently cited facility in each cluster was considered the preferred facility for that cluster. This information was linked to the master file of verified health facilities. The sample for the health facility audit was made up of all high-volume health facilities, all public-sector facilities, and a sample of the preferred facilities. A total of 400 health facilities (hospitals, health centers, maternity homes, nursing homes, and child welfare clinics) across the six cities were surveyed (96 high-volume facilities and 304

non-high volume facilities). A survey of service providers in the selected health facilities was conducted. Service providers were eligible to participate in the survey if they met the following criteria: a) medically-trained; b) permanently employed (full-time or part-time); and c) provide direct clinical reproductive health services. The list of eligible service providers that were on duty on the day of the facility audit was used as the sampling frame. A maximum of four service providers per facility was sampled. In facilities where there were less than four eligible service providers, all service providers were sampled; while in facilities where there were more than four eligible service providers, a simple random sampling procedure was used to select four service providers. A total of 1,479 service providers in all health facilities were interviewed. Information on sociodemographic characteristics, qualifications, previous and recent FP training, and provision of FP services were collected.

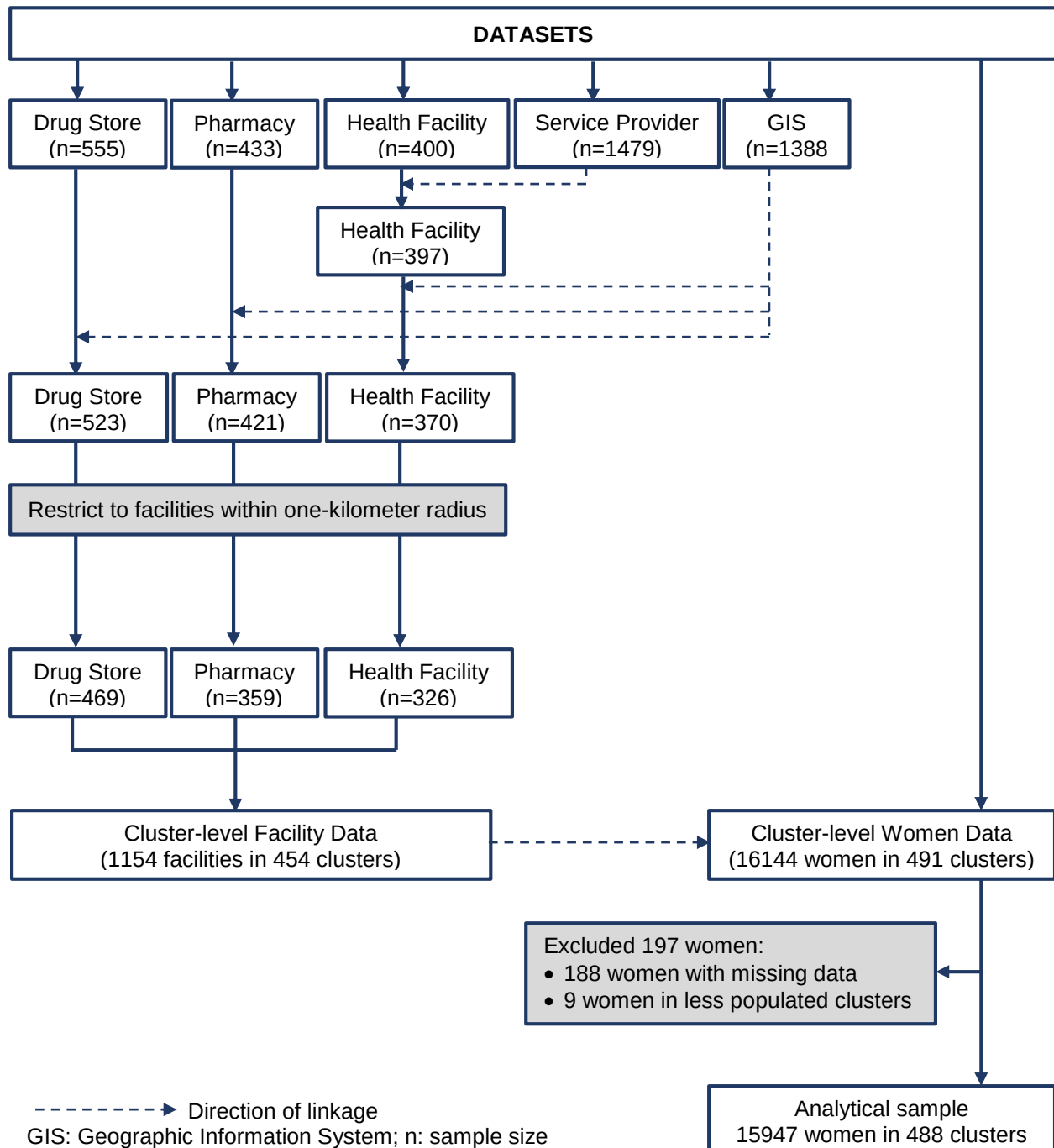
- Pharmacy audit: The sampling goal was to include 100 pharmacies per city. A simple random sampling procedure was used to select 100 pharmacies in each city. Where the number of pharmacies was less than 100, all pharmacies in the city were included in the sample. A total of 433 pharmacies were surveyed.
- Drug store audit: Likewise, the goal was to include 100 drug stores in each city. A simple random sampling procedure was used to select a sample in all cities except Abuja where there were less than 100 drug stores. All drug stores in Abuja were included in the sample. A total of 555 drug stores were surveyed in all cities.
- GIS dataset: This dataset contained information on the longitude, latitude, and distance of the surveyed facilities (health facilities, pharmacies, and drug stores) from the centroid of the all the sampled clusters. There was GIS information on 1,388 facilities in 491 clusters.

The difference between drug stores and pharmacies is that pharmacies are owned by registered pharmacists while drug stores are usually owned by non-medical personnel. Upon informed consent, the manager in the selected facilities was interviewed to obtain information on the infrastructure, client load, provider characteristics, type and quality of services provided, and types of modern methods offered. Detailed information about the facility audits and service provider survey are published elsewhere [149].

Data

Data from the aforementioned datasets were linked to provide information on the factors that exist on the five socioecological levels. *Figure 3.2* shows the data linkage and sample selection flowchart. The service provider dataset was linked to the health facility dataset to provide information on the average provider characteristics per health facility. Three health facilities were dropped from the sample because they had missing service provider data. The GIS dataset was linked to the facility dataset containing data from the three facility types. Facilities were dropped from the sample if they had missing GIS data (32 drug stores, 12 pharmacies, and 27 health facilities). Data on facilities within a one-kilometer radius of the centroid of the clusters were retained – 1,154 facilities within a one-kilometer radius of centroids of 454 clusters. The one-kilometer radius was thought to be an appropriate distance that women may be willing to travel for health services in densely-populated urban areas. The facility dataset was then linked to the women's dataset. The women's dataset contained information on 16,144 women in 491 clusters. Women were dropped from the sample if they had missing data on any of the variables ($n=188$) or lived in clusters with fewer than five women ($n=9$). The rationale for dropping women in less-populated clusters was based on a Monte Carlo simulation study that found that multilevel models provide reliable and valid estimates if the groups had at least five observations [150]. Thus, the analytical sample was made up of 15,947 women with information on the characteristics of 1,154 facilities located within a one-kilometer radius of the centroids of 488 clusters.

Figure 3.2: Data Linkage and Sample Selection Flowchart



Measures

Outcome variable

A binary outcome variable measured modern method use at the time of survey. This variable was created from two sequential questions from the women's survey that asked: a) "*are you (or your partner) currently doing something or using any method to delay or avoid getting pregnant?*" and b) "*which method(s) are you (or your partner) currently using?*" Women were coded '1' if they responded affirmatively to the first question and, in response to the second question, chose any of the following contraceptive methods: daily pills, injectables, implants, intrauterine devices, sterilization (female or male), diaphragms, emergency pills, spermicides (gels or foams), condoms (male or female), and lactational amenorrhea; or coded '0' otherwise.

Exposure variables

The exposure variables were identified from previous literature and conceptualized to exist on multiple levels of influence of the Socioecological Framework. They are described below (see *Table 3.1*).

- *Intrapersonal factors*: The factors on this level were from the women's dataset. Precisely, the women's ages at the time of survey were categorized into '15-24', '25-34', and '35-49' age groups and the educational attainment was grouped into 'none', 'primary', 'secondary', and 'tertiary' education. Marital status was dichotomized into 'ever married/cohabited' versus 'never married/cohabited' while religion was dichotomized into 'Muslim' versus 'non-Muslim'. The number of children ever born was categorized into 'none', '1-4', or '5 or more' children. The employment status was assessed using two questions that asked the women if they had done any work in the past year and whether they were paid in cash or kind for the work. Women who were paid in cash or kind for their work were coded '1' while those who were not paid or did not work were coded '0'. The wealth status was assessed based on principal component analyses of ownership of several household items and categorized into quintiles ranging from poorest to richest households (*Appendix Table A1*). The women's self-efficacy towards FP was assessed with an 8-item Likert scale (*Appendix Table A1*). This scale had a Cronbach's alpha value of 0.93 and scores ranged from zero to eight; increasing scores indicated higher levels of FP self-efficacy. The scores were further categorized into 'no' (score=0), 'low' (score=1-4), and 'high' (score=5-8) levels.

- Interpersonal factors: Two variables from the women's dataset assessed interpersonal interactions. The first variable was measured using two questions asked to women who reported having a partner: a) *"Have you and your spouse/partner ever discussed the number of children you would like to have?"* and b) *"Have you ever discussed the use of family planning method with your spouse/partner?"* The response options were 'yes' or 'no'. These responses were recoded to a new variable termed 'fertility discussion with male partner' that had four categories: 'never discussed desired parity or FP', 'discussed either desired parity or FP', 'discussed both desired parity and FP', and 'no current partner'. The second variable at this level was measured with this question: *"Do you think there are some people within this community who will call you bad names or avoid your company if they knew that you were using a family planning/contraceptive method?"* The response options were 'yes' or 'no'.

- Institutional factors: Three variables created using information from the facility, service provider, and GIS datasets measured geographic access to FP services in the three facility types located within a one-kilometer radius of the centroid of the clusters: 'access to FP services in health facilities', 'access to FP services in pharmacies', and 'access to FP services in drug stores'. The measures used to create these variables included the following characteristics: 1) at least one facility in the specified distance; 2) at least one facility in the specified distance provides FP services; 3) at least one facility in the specified distance has a FP-trained provider; 4) at least one facility in the specified distance provides ideal FP method mix (a combination of long and short acting modern methods); 5) at least one facility in the specified distance did not have method stock-out in the past year; and 6) at least one facility in the specified distance does not require partner consent for method provision. These measures were summed for each facility type with scores ranging from zero to six; increasing score indicated increasing access to FP services in the facility type. These facility variables were defined at the cluster-level and then matched to women living in those clusters. There were some clusters with no facility within a one-kilometer radius; women in those clusters were classified as having a score of zero. The scores were further categorized into 'no access' (score=0), 'low access' (score=1-4), and 'high access' (score=5-6).

- Community factors: Three variables from the women's dataset included at this level assessed whether the woman lived in: 1) poor clusters (more than 50% of other women in the same cluster live in poor/poorest households); 2) large ideal family size clusters (other women in the same

cluster reported wanting an average of five or more children); and 3) FP-media exposed clusters (more than 50% of the other women in the same cluster reported being exposed to FP messages in the media in the three months prior to survey). These three variables were each dichotomized into 'yes' or 'no'. The community factors were created by aggregating the women's individual responses to the cluster level, subtracting the index woman's response, and dividing by the number of other women in the cluster to give a cluster-level mean value reflective of the characteristics of other women in the same cluster.

- **Societal factors**: The city variable was used as a proxy for the local and state government FP policies and programs the women within the cities were experiencing at the time of survey. Six cities were included in this study: Abuja, Benin, Ibadan, Ilorin, Kaduna, and Zaria.

Table 3.1: List and sources of variables used in modeling modern method use in six cities in Nigeria		
Variable	Data source	Response categories
Outcome variable		
Modern method use	Women's survey	Yes or No
Exposure variables		
a. Intrapersonal factors		
Age	Women's survey	15-24, 25-34, or 35-49
Education	Women's survey	None, Primary, Secondary, or Higher
Marital history	Women's survey	Ever or Never married/cohabited
Religion	Women's survey	Muslim or Non-Muslim
Parity (children ever born)	Women's survey	None, 1-4, vs. 5 or more
Gainful employment in past year	Women's survey	Yes or No
Household wealth index	Women's survey	Poorest, Poor, Middle, Rich, or Richest
Self-efficacy towards FP	Women's survey	No, Low, or High efficacy
b. Interpersonal factors		
Fertility discussion with partner	Women's survey	No, Discussed either parity or family planning, Discussed both parity and planning, or No partner
Perceive others' negative attitudes towards her FP use	Women's survey	Yes or No
c. Institutional factors		
Access to FP services in health facility	Health facility audit	No, Low, or High access
Access to FP services in pharmacy	Pharmacy audit	No, Low, or High access
Access to FP services in drug store	Drug store audit	No, Low, or High access
d. Community factors[†]		
Poor cluster	Women's survey	Yes or No
Cluster with large family size norm	Women's survey	Yes or No
Cluster with FP in media exposure	Women's survey	Yes or No
e. Societal factors		
City of residence	Women's survey	Abuja, Benin, Ibadan, Ilorin, Kaduna, or Zaria

†: cluster averages exclude that of index woman (i.e. non-self means); FP: Family Planning

Statistical analyses

Descriptive analyses were conducted (proportions, means and standard deviations) to provide information about the characteristics of the analytical sample. Multilevel models were run to estimate the associations between the socioecological factors and modern method use. In this study, women ‘i’ were nested within clusters ‘j’; thus the assumption of independence among women within the same cluster and the assumption of equal variance across all clusters were violated. This clustering effect, if not accounted for, results in inflation of the estimated standard errors leading to incorrect significance testing of the study hypotheses. Multilevel models assume hierarchical data structure with the outcome variable measured at the lowest level and the exposure variables measured at the hierarchical levels, correcting any clustering effects that may exist [143]. Also, multilevel models partition the variance in the outcome variable into within-cluster variance (differences between observations within the same cluster) and between-cluster variance (differences between clusters). In this study, multilevel models were estimated sequentially starting with a null model (intercept-only model) that tested the null hypothesis that there was no between-cluster variation in modern method use.

Given the binary outcome variable, multilevel logit models were fitted. In multilevel logit models, the within-cluster variance (σ^2) is standardized and fixed at the value of $\pi^{2/3}$ [144]. The null model (Model 0; Equation 3.1) provided an estimate of the between-cluster variance, which was used to calculate the intra-cluster correlation coefficient (ICC) and the median odds ratio (MOR). The MOR transforms the between-cluster variance to an odds ratio scale providing information on the median value of the odds ratios between clusters with high MCPR and clusters with low MCPR. MOR is said to be a better measure of community heterogeneity in multilevel logit models compared to ICC because the MOR is independent of the prevalence of the outcome variable [142].

$$\textbf{Model 0: } \log\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \gamma_{0j} + u_{0j} + e_{ij} \quad \dots\dots\dots \text{(Equation 3.1)}$$

Where: π_{ij} = *estimated probability of outcome variable = 1 for individual ‘i’ in group ‘j’*
 γ_{0j} = *group-specific intercept*
 u_{0j} = *community-level random effects*
 e_{ij} = *individual-level random effects*

Although the socioecological factors existed on five hierarchical levels, these levels of influence were collapsed into two statistical levels: individual-level (intrapersonal and interpersonal factors) and community-level (institutional, community, and societal factors). Three study hypotheses were tested:

- 1) Individual-level factors are associated with modern method use among women (ages 15-49) living in six cities in Nigeria (Model 1; *Equation 3.2*);

Model 1: $\log\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \gamma_{0j} + \beta X_{ij} + u_{0j} + e_{ij}$ (Equation 3.2)
 Where: βX_{ij} = coefficients of the individual-level exposure variables

- 2) Controlling for individual-level factors, community-level factors are associated with modern method use among women (ages 15-49) living in six cities in Nigeria (Model 2; *Equation 3.3*);

Model 2: $\log\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \gamma_{0j} + \beta X_{ij} + \delta Z_j + u_{0j} + e_{ij}$ (Equation 3.3)
 Where: δZ_j = coefficients of the community-level exposure variables

- 3) Community-level factors modify the association between individual-level factors and modern method use among women (ages 15-49) living in six cities in Nigeria (Model 3; *Equation 3.4*).

Model 3: $\log\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \gamma_{0j} + \beta X_{ij} + \delta Z_j + \phi X_{ij}Z_j + u_{0j} + e_{ij}$ (Equation 3.4)
 Where: $\phi X_{ij}Z_j$ = coefficients of the interaction between individual-level & community-level exposure variables

All analyses were conducted using Stata version 14 [151]. The variance inflation factors (VIF) of all variables were estimated to test for collinearity between variables. The multilevel models were estimated using a user-written Stata command 'gllamm' through a discrete factor approximation – a non-parametric maximum likelihood estimator [144]. The 'gllamm' command fits a group of multilevel latent variables model for several types of outcome variables including continuous, count, binary, ordered, and unordered categorical variables. Since the coefficients in a logit model (non-linear model) cannot be interpreted directly, post-estimation conversion of coefficients to odds ratios (OR) were performed. Additionally, post-estimation goodness-of-fit tests were conducted to assess how well the models fit the data. The tests included comparing the models' Log Likelihood and AIC values (lower values indicate better model fit), and conducting the LR tests of nested models. Sensitivity analyses comparing the estimates from the multilevel logit models to those from single-level logit models with post-estimation

correction of clustered standard errors produced similar coefficients and significance tests except for those of the cross-level interaction terms, which were not significant in the single-level models. The results of the multilevel logit models and the goodness-of-fit tests are described in the results section.

Ethical approval

The MLE Project obtained ethical approval for all its protocol and procedures from the Nigeria Health and Research Ethics Committee and the University of North Carolina at Chapel Hill Institutional Review Board. Verbal informed consent was obtained from all respondents prior to study participation. Instead of written informed consent, verbal consent was obtained because of the sensitive nature of the questions asked, such as information on sexual and reproductive behaviors. As done in these types of surveys, women who were under 18 (ages 15-17) also provided verbal consent to be interviewed. The interviewers documented the receipt of verbal informed consent on the individual consent forms.

Results

Sample characteristics

Table 3.2 shows the distribution of the individual-level factors. Of the 15,914 women, 35% were aged 15-24 years, 36% were aged 25-34 years, while 29% were aged 35-49 years. About three-quarters of the women had secondary or tertiary education (50% and 24%, respectively) and two-thirds (66%) had ever been married or cohabited with a male partner. One-half of the women were Muslims while the other half were mainly Christians with less than 1% having indigenous or no religious affiliation. Although about 37% of the women had no children, 45% had one to four children and 19% had five or more children. One-half of the women were employed in the year prior to survey. The household wealth groups were evenly split across the quintiles. Of the 8-point scale, the mean FP self-efficacy score was 4.31. Although a majority (58%) were classified as having high FP self-efficacy, about 20% had a score of zero reflecting no FP self-efficacy while 22% were classified as having low FP self-efficacy. About 21% of the women reported discussing their desired number of children and FP use with their male partners, another 18% reported discussing either desired parity or FP use, while 24% reported never having such discussions.

About 37% of the women did not have a partner at the time of the survey. About 13% of the women perceived they would be stigmatized if other community members thought they were using a FP method.

Table 3.2: Individual-level characteristics of women aged 15-49 years in six cities in Nigeria	
	Weighted values
Intrapersonal factors	
Age, %	
15 – 24 years	35.30
25 – 34 years	36.15
35 – 49 years	28.55
Education, %	
None/Quranic	11.69
Primary	14.35
Secondary	49.81
Higher	24.15
Marital history, %	
Ever married/cohabiting	65.85
Never married/cohabiting	34.15
Religion, %	
Muslim	49.89
Non-Muslim (Christian, Other, or None)	50.11
Parity (children ever born), %	
None	36.73
1-4 children	44.53
5 or more children	18.74
Gainful employment in last year, %	
Yes	51.18
No	48.82
Household wealth index, %	
Poorest	18.35
Poor	19.29
Middle	20.10
Rich	20.90
Richest	21.36
Self-efficacy towards FP use score [range: 0 – 8]	
Mean (SD)	4.31 (2.66)
No FP self-efficacy (score = 0)	19.84
Low FP self-efficacy (score = 1-4)	21.93
High FP self-efficacy (score = 5-8)	58.23
Interpersonal factors	
Fertility discussion with male partner, %	
Never discussed parity or FP use	23.90
Discussed either parity or FP use	17.92
Discussed both parity and FP use	20.79
No current partner	37.39
Perceive others' negative attitudes towards her FP use, %	
Yes	13.44
No	86.56
Number of women	15947
FP: Family Planning; SD: Standard Deviation	

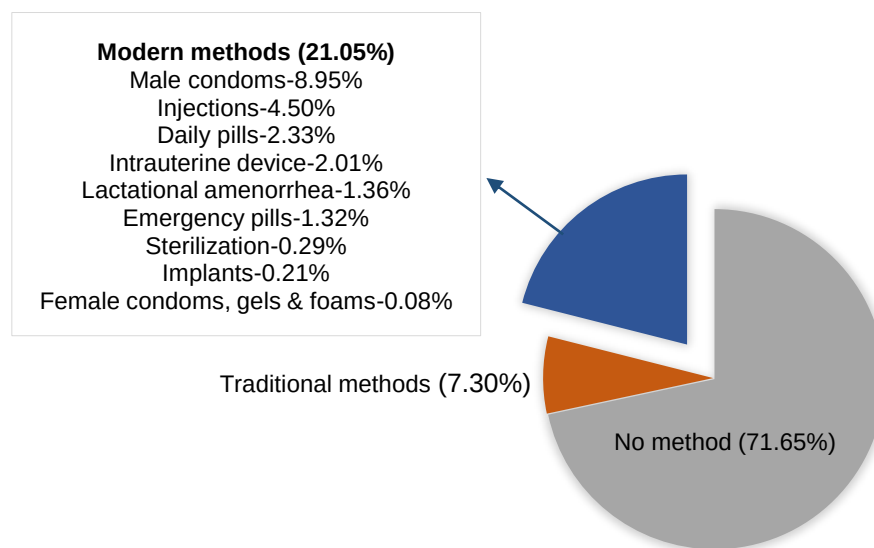
Table 3.3 shows the distribution of the community-level factors. The mean score of FP access in health facilities was 3.94; about 20% of the women lived in clusters with no access (score=0), 29% lived in clusters with low access (score=1-4), while 51% lived in clusters with high access (score=5-6).

Table 3.3: Community-level characteristics of women aged 15-49 years in six cities in Nigeria	
	Weighted values
Institutional factors	
Access to FP services in health facility score [range: 0-6]	
Mean (SD)	3.94 (2.27)
No access (score = 0)	19.74
Low access (score = 1-4)	29.09
High access (score = 5-6)	51.17
Access to FP services in pharmacy score [range: 0-6]	
Mean (SD)	3.08 (2.65)
No access (score = 0)	39.56
Low access (score = 1-4)	12.96
High access (score = 5-6)	47.48
Access to FP services in drug store score [range: 0-6]	
Mean (SD)	3.19 (2.21)
No access (score = 0)	27.34
Low access (score = 1-4)	42.00
High access (score = 5-6)	30.66
Community factors	
Live in a poor cluster, %	
Yes	29.77
No	70.23
Live in a cluster with large family size norm, %	
Yes	16.87
No	83.13
Live in a cluster with FP in media exposure, %	
Yes	60.17
No	39.83
Societal factors	
City of residence, %	
Abuja	12.75
Benin	12.92
Ibadan	19.69
Ilorin	16.44
Kaduna	25.64
Zaria	12.56
Number of women	15947
Number of clusters	488
Women per cluster	
Mean (SD)	36.43 (10.90)
Median (range)	35 (6-71)
SD: Standard Deviation; FP: Family Planning; Poor cluster: where >50% of other women in the cluster live in households classified as poor or poorest households; Cluster with large family size norm: where the average ideal number of children of other women in the cluster is 5 or more children; Cluster with family planning in media exposure: where >50% of other women in the cluster report exposure to family planning messages in the media in the last 3 months.	

The mean score of FP access in pharmacies was 3.08 with 40%, 13%, and 47% having no, low, and high access to FP services in pharmacies, respectively. For the drug stores, the mean score was 3.19 with 27%, 42%, and 31% having no, low, and high access to FP services in drug stores, respectively. A third (30%) of the women lived in clusters classified as poor. Additionally, 17% lived in clusters classified as having large ideal family size and 60% lived in clusters classified as having FP-media exposure. On average, there were 36 women per cluster with a range of 6 to 71 women per cluster.

As shown in *Figure 3.3*, about one in five women (21%) were using a modern method at the time of survey. The most prevalent modern methods were male condoms (9%), injections (5%), daily pills (2%), and intrauterine device (2%). The other methods reported were emergency pills (1%) and lactational amenorrhea method (1%) while less than 1% reported using sterilization, implants, female condoms, gels and foams as their contraceptive methods. Another 7% reported using traditional methods such as withdrawal method and cycle beads but a majority (72%) reported not using any contraceptive method. There were variations in the proportions of women using modern methods by city: Abuja (29%), Benin (25%), Ibadan (29%), Ilorin (21%), Kaduna (17%), and Zaria (5%) [Data not shown]. Male condoms and injections were the two prevalent methods in all cities.

Figure 3.3: Contraceptive method use among women (ages 15-49) in six cities in Nigeria



Multilevel modelling of modern method use

Table 3.4 shows the multilevel results; the results of Models 0 and 1 are summarized while the results of Model 2 are discussed in details. Model 0 (null model) provided information on the between-cluster variance. With a between-cluster variance of 0.82 ($p < 0.001$), the estimated ICC was 0.20 meaning that 20% of the variance in modern method use was explained by the variation between clusters. The MOR was 2.36, indicating that women living in clusters with higher MCPR were more than twice as likely to use modern methods compared to women living in clusters with lower MCPR. Model 1 tested the first study hypothesis: the individual-level factors are associated with modern method use. This hypothesis was found to be true as age, education, marital history, parity, employment, and fertility discussion with male partner were positively associated with modern method use while being Muslim, having no or low FP self-efficacy, and fearing negative attitudes from community members about FP use were negatively associated with modern method use. Also, compared to women in the poorest households, women in richest households had lower odds of modern method use. Inclusion of the individual-level factors reduced the between-cluster variance from 0.82 to 0.33. This reduction suggests that the individual-level factors explained about 60% of the between-cluster variation in the odds of using modern methods.

Model 2 simultaneously estimated the direct effects of the individual-level and community-level factors on modern method use, testing the second study hypothesis. The estimated associations at each of the five socioecological levels are described below. This model had a residual between-cluster variance of 0.10, a reduction from 0.82 of the null model. This reduction indicated that the individual and community factors explained 88% of the between-cluster variation in the odds of modern method use.

- Effects at the intrapersonal level: Several factors at this level were found to be significantly associated with modern method use, controlling for factors on the other levels. Specifically, compared to women aged 15-24, those aged 25-34 and 35-49 years had 90% and 72% higher odds of using a modern method, respectively (OR: 1.72-1.90; $p < 0.001$). Despite having increased odds of modern method use for those with primary and secondary education compared to those with no formal education, only women with tertiary education had statistically significant higher odds of modern method use (OR: 1.71; $p < 0.001$). Compared to women who had ever been in-union (married/cohabited), women who

had never been in-union had six times higher odds of reporting modern method use (OR: 5.87; $p<0.001$). Additionally, compared to women with no children, those who with children had higher odds of modern method use (OR: 2.32 for women with 1-4 children, OR: 3.35 for women with 5 or more children; $p<0.001$). Women who were employed had 21% higher odds of modern method use compared to those who were not employed (OR: 1.21; $p<0.05$). On the other hand, Muslim women had lower odds of modern method use compared to non-Muslim women (OR: 0.85; $p<0.01$); women in the wealthiest households had lower odds of modern method use compared to those in the poorest households (OR: 0.80; $p<0.05$). All the other wealth groups were not statistically different from the poorest wealth group. Compared to women classified as having high FP self-efficacy, women who had no or some FP self-efficacy had lower odds of modern method use (OR: 0.12-0.49; $p<0.001$).

- Effects at the interpersonal level: The two factors included at this level were found to be significantly associated with modern method use, controlling for factors on the other levels. Compared to women who did not have fertility discussions with their male partners, those who discussed either desired parity or FP use had 1.5 times higher odds of modern method use (OR: 1.51; $p<0.001$) while those who discussed both desired parity and FP use had four times higher odds of modern method use (OR: 4.02; $p<0.001$). There was no difference between women who did not have such discussions with their male partners and those who did not have a partner at the time of survey ($p>0.05$). Additionally, women who perceived that the other community members would stigmatize them for practicing FP had lower odds of modern method use compared to those who did not have such perceptions (OR: 0.85; $p<0.05$).

- Effects at the institutional level: Controlling for factors on the other levels, none of the institutional-level factors had statistically significant associations with modern method use ($p>0.05$). In other words, having access to FP services in health facilities, pharmacies, or drug stores located within one-kilometer radius of centroids of the clusters where the women lived did not influence the women's odds of modern method use.

- Effects at the community level: Three variables were included at this level; however, only one factor had statistically significant association with modern method use controlling for factors on the other levels. Women who lived in clusters classified as having FP-media exposure had higher odds of modern method use compared to those who lived in clusters not classified as having FP-media exposure

(OR: 1.18; $p < 0.05$). Living in poor clusters or in clusters with large ideal family size was not significantly associated with the odds of modern method use ($p > 0.05$).

- Effects at the societal level: Controlling for factors on the other levels, women who lived in Benin, Kaduna, and Zaria had 28%, 39%, and 74% lower odds of modern method use compared to women in the capital city, Abuja ($p < 0.01$). Women who lived in Ibadan and Ilorin were not statistically different from those who lived in Abuja in terms of their odds of modern method use.

	Model 0 OR (95% CI)	Model 1 OR (95% CI)	Model 2 OR (95% CI)
Individual-level effects			
Age			
15-24 years	ref	ref	ref
25-34 years	---	1.94 (1.68-2.24)***	1.90 (1.65-2.20)***
35-49 years	---	1.83 (1.53-2.18)***	1.72 (1.44-2.05)***
Education			
None/Quranic	ref	ref	ref
Primary	---	1.23 (0.99-1.52)	1.16 (0.94-1.43)
Secondary	---	1.28 (1.05-1.56)*	1.21 (0.99-1.48)
Higher	---	1.79 (1.45-2.23)***	1.71 (1.40-2.12)***
Marital history			
Ever married/cohabited	ref	ref	ref
Never married/cohabited	---	6.29 (4.42-8.96)***	5.87 (4.12-8.38)***
Religion			
Non-Muslim	ref	ref	ref
Muslim	---	0.81 (0.72-0.90)***	0.85 (0.76-0.95)**
Parity			
0 child	ref	ref	ref
1-4 children	---	2.34 (1.88-2.92)***	2.32 (1.86-2.89)***
5 or more children	---	3.06 (2.37-3.96)***	3.35 (2.59-4.33)***
Employed in last year			
No	ref	ref	ref
Yes	---	1.26 (1.13-1.40)***	1.21 (1.08-1.35)*
Household wealth index			
Poorest	ref	ref	ref
Poor	---	1.15 (0.99-1.34)	1.11 (0.95-1.29)
Middle	---	1.12 (0.96-1.31)	1.10 (0.94-1.28)
Rich	---	1.01 (0.86-1.19)	0.99 (0.85-1.17)
Richest	---	0.80 (0.68-0.95)*	0.80 (0.67-0.95)*
Family planning self-efficacy			
High self-efficacy	ref	ref	ref
No self-efficacy	---	0.11 (0.09-0.14)***	0.12 (0.09-0.15)***
Some self-efficacy	---	0.47 (0.41-0.53)***	0.49 (0.43-0.55)***

Table 3.4 continued			
Fertility discussion with partner			
Never	ref	ref	ref
Discussed either parity or FP use	---	1.65 (1.40-1.94)***	1.51 (1.28-1.78)***
Discussed both parity and FP use	---	4.43 (3.80-5.18)***	4.02 (3.45-4.70)***
No current partner	---	0.90 (0.65-1.22)	0.87 (0.64-1.19)
Others' negative attitude to her FP use			
No	ref	ref	ref
Yes	---	0.81 (0.70-0.94)**	0.85 (0.73-0.98)*
Community-level effects			
Access to FP in health facility			
Low access	ref	ref	ref
Some access	---	---	0.87 (0.74-1.04)
High access	---	---	1.02 (0.87-1.20)
Access to FP in pharmacy			
Low access	ref	ref	ref
Some access	---	---	1.09 (0.91-1.31)
High access	---	---	0.91 (0.80-1.03)
Access to FP in drug store			
Low access	ref	ref	ref
Some access	---	---	1.16 (1.01-1.34)*
High access	---	---	1.14 (0.96-1.36)
Live in a poor cluster			
No	ref	ref	ref
Yes	---	---	1.03 (0.90-1.19)
Live in large family size cluster			
No	ref	ref	ref
Yes	---	---	0.90 (0.76-1.06)
Live in a FP-in-media cluster			
No	ref	ref	ref
Yes	---	---	1.18 (1.04-1.33)*
City of residence			
Abuja	ref	ref	ref
Benin	---	---	0.73 (0.60-0.88)**
Ibadan	---	---	0.98 (0.80-1.20)
Ilorin	---	---	0.87 (0.70-1.06)
Kaduna	---	---	0.61 (0.49-0.76)***
Zaria	---	---	0.25 (0.19-0.33)***
Intercept	0.22 (0.20-0.24)***	0.03 (0.02-0.04)***	0.04 (0.03-0.06)***
Community-level variance	0.82***	0.33***	0.10
Proportion explained by model ^β	reference	0.60	0.88
Median Odds Ratio (MOR)	2.36	1.73	1.35
Intra-class correlation coefficient (ICC)	0.20	0.09	0.03
Log-likelihood Ratio (Chi-square) test ^β	reference	2184.37***	2383.54***
Log-likelihood	-7518.75	-6426.56	-6326.98
Akaike Information Criteria (AIC)	15047.49	12903.12	12731.95
Bayesian Information Criteria (BIC)	15085.88	13095.05	13031.36
^α Increase in score indicates greater value of the variable; ^β Compared to the null model (i.e. model with no covariates); OR: Odds Ratio; 95% CI.: 95% Confidence Interval; [†] p<0.10; *p<0.05; **p<0.01; ***p<0.001; Model 0: Null model; Model 1: Multivariate multilevel model including individual-level variables only; Model 2: Multivariate multilevel model including individual-level and neighborhood-level variables; Poor cluster: where more than 50% of other women in the cluster live in households classified as poor or poorest households; Cluster with large family size norm: where the average ideal number of children of other women in the cluster is 5 or more children; Cluster with family planning in media exposure: where more than 50% of other women in the cluster report exposure to family planning messages in the media in the last 3 months.			

In addition to estimating the direct associations between socioecological factors and modern method use, some cross-level interaction associations were estimated, testing the third study hypothesis. The estimated cross-level effects were selected based on the fact that, if significant, they may be easily addressed through a FP program. The direct associations at all the levels remained the same except for those of the variables included in the interaction terms. Thus, only the cross-level interaction associations are discussed below and shown in *Table 3.5*.

- Cross-level interaction: The first interaction was between the individual-level parity (number of children ever born) and the community-level ideal family size (average ideal number of children of the other women in the same cluster). This interaction was found to be statistically significant suggesting that living in a cluster with a large ideal family size (average of 5 or more children) modified the association between parity and modern method use. Specifically, women with 1-4 children living in large ideal family size clusters had lower odds of modern method use compared to those with no children living in the same cluster (OR: 0.71; $p<0.05$). Likewise, women with five or more children living in large ideal family size clusters had lower odds of modern method use compared to those with no children living in same clusters (OR: 0.64; $p<0.05$). On the other hand, compared to women with no children living in the small ideal family size clusters, women with 1-4 children living in the same cluster had 2.4 times higher odds of modern method use (OR: 2.42; $p<0.001$) while those with 5 or more children living in the same cluster had 3.6 times higher odds of modern method use (OR: 3.55; $p<0.001$). For women with no children, there was no significant difference in their modern method use depending on whether they lived in large versus small ideal family size clusters ($p>0.05$). The second interaction was between individual-level employment status and community-level poverty level. This interaction was also found to be statistically significant meaning that living in a poor cluster modified the association between individual-level employment status and modern method use. Employed women in poor clusters had 32% higher odds of modern method use compared to unemployed women in poor clusters (OR: 1.32; $p<0.05$) while employed women in non-poor clusters had 13% higher odds of modern method use compared to unemployed women in non-poor clusters (OR: 1.13; $p<0.05$). There was no significant difference in the odds of modern method use between employed women in poor clusters and employed women in non-poor clusters ($p>0.05$).

Table 3.5: Cross-level interaction effects on modern method use in urban Nigeria	
	OR (95% CI)
Community-level ideal family size X individual-level parity	
Clusters with large ideal family size	
Parity=0 child	ref
Parity=1-4 children	0.71 (0.52-0.97)*
Parity=5 or more children	0.64 (0.44-0.93)*
Clusters with small ideal family size	
Parity=0 child	ref
Parity=1-4 children	2.42 (1.94-3.02)***
Parity=5 or more children	3.55 (2.74-4.61)***
Parity=0 child	
Live in a cluster with small ideal family size	ref
Live in a cluster with large ideal family size	1.17 (0.91-1.52)
Community-level poverty X individual-level employment status	
Poor cluster	
Not employed	ref
Employed	1.32 (1.06-1.64)*
Non-poor cluster	
Not employed	ref
Employed	1.13 (1.01-1.27)*
Employed	
Live in non-poor cluster	ref
Live in poor cluster	0.87 (0.71-1.05)
^β Compared to the null model (i.e. model with no covariates); OR: Odds Ratio; CI.: Confidence Interval; FP: Family Planning; [†] p<0.10; *p<0.05; **p<0.01; ***p<0.001; Model included individual-level, community-level, and cross-level interaction variables; Poor cluster: >50% of other women in the same cluster live in poor/poorest households; Large ideal family size cluster: average ideal number of children of other women in the same cluster is 5 or more children.	

Discussion and Conclusion

This study aimed to provide a multilevel analysis of the determinants of modern method use in urban Nigeria, a diverse and growing region of sub-Saharan Africa. The study findings indicate that several factors existing on multiple socioecological levels were significantly associated with modern method use among reproductive-age women living in six cities in Nigeria. The finding that intrapersonal factors such as age, education, marital history, religion, parity, employment, and FP self-efficacy were significantly associated with modern method use is consistent with previous findings in the literature [31, 95, 42]. However, the finding that belonging to the richest households was negatively associated with modern method use is inconsistent with previous studies. This finding remained significant even after excluding education and employment status from the model. A further analysis revealed that a higher proportion of women in the richest households (27%) reported having no children compared to women in

the poorest households (16%). Additionally, a higher proportion of women in the richest households (25%) reported not having a current partner compared to women in the poorest households (18%). Thus, it could be that women in the richest households did not report using modern methods because they wanted to have children or they were not sexually-active at the time of survey – hence, they have lower need for contraception. These findings at the intrapersonal level highlight potential target populations for FP programs. Our findings suggest that young women (ages 15-24), women in-union, Muslim women, and women with no formal education had lower odds of using modern methods. Although it is possible that these women were not in need of modern contraception at the time of survey, programs looking to improve MCPR in urban areas may find that reaching these women with FP messages may contribute to increases in the uptake and use of modern methods. Such programs may aim to improve the knowledge of and attitudes towards FP for when contraception is needed.

The findings at the interpersonal level indicated that male partners played an important role on use of modern methods as women who had fertility discussions with their male partners had higher odds of modern method use. This finding is consistent with results from previous studies [36, 38], further reinforcing the need to promote spousal/partner communication as a means to improve MCPR. FP programs need to highlight the benefits of having such conversations through empowering women to have the capability to initiate such discussions and/or by encouraging men to do so. Programs also need to emphasize the continuity of such conversations as evidence suggests a positive dose-effect relationship between the frequency of partner discussion about FP and modern method use [38]. Our study also found that the perception of FP disapproval from other community members was associated with decreased odds of modern method use. This finding highlights the existence of social pressure to conform to normative behaviors. Other studies from Nigeria also found positive associations between widespread FP approval and modern method use [76, 44]. The negative attitudes towards FP at the community-level often stem from the misconceptions about the adverse effects of contraceptive methods. A recent study found that the prevalence of myths and misconceptions about the side effects of modern methods was high in Kenya, Nigeria, and Senegal [64]. According to the study, both men and women erroneously believed that modern methods damage the uterus and were dangerous to women's health;

women who held such misconceptions had lower odds of modern method use. Thus, FP interventions need to accurately inform the community about the mechanisms of action and potential side effects of the different types of modern methods to dispel such myths. Studies on FP counseling have shown that women who were informed of the potential side effects of a modern method were more likely to continue using the chosen method over time compared to those who did not receive such information and thus discontinued method use when they experienced side effects [26, 152]. The FP interventions geared at improving the knowledge of and attitudes towards FP should be implemented at the community level as they are likely to reach a broader audience compared to the facility-based interventions. One way to target a broader audience is through mass media interventions and/or community outreach programs.

Additionally, this study found that the characteristics of the community where the women resided had considerable effects on the odds of modern method use. Community exposure to FP messages in the media had a positive association with modern method use. This finding supports the evidence that mass media interventions are effective ways to improve FP knowledge, which will in turn increase modern method adoption and use [115, 153, 154]. Another contribution of this study is the estimation of the modifying effects of community-level factors on the association between individual-level factors and modern method use. The finding that employed women had higher odds of modern method use is consistent with previous studies [51, 114]. However, this study suggests that employment may matter more in poor communities than in non-poor communities as the effect size for employment in poor communities was larger than the effect size for employment in non-poor communities. This finding underscores the need for employment opportunities for women especially among those living in poor communities. Another interesting contribution of this study is the estimation of the modifying effect of living in clusters with ideal family size on the association between individual-level parity and modern method use. Previous studies suggest that women living in communities where large family size is the norm are less likely to use modern methods [155]. However, there is no information on the interaction effect of community fertility norms and individual parity on modern method use. This study found that women with children living in communities with small ideal family size had higher odds of modern method use while women with children living in communities with large ideal family size had lower odds of modern

method use. This contradictory finding supports the construct of peer modelling of behaviors or observational learning, which describes how behaviors are learned from observing people (friends and neighbors) practice the behavior. Given that large family size is still desirable in urban Nigeria [24], FP interventions need to emphasize small family size in their programs.

This study did not find any significant associations between modern method use and having access to FP services in facilities within a one-kilometer radius of their community of residence. This finding is surprising as the literature suggests that having access to FP services increases the odds of modern method use [17, 31, 34]. Access to modern contraception has been described as comprising of geographic, economic, information, psychosocial, and administrative access [17]. This study examined mainly geographic access to FP services. Urban areas often have higher geographic access to health services compared to rural areas, so it is possible that other aspects of access may be playing a bigger role in urban areas. Future studies should examine what aspect of access to FP services matters in urban areas in order to better inform programs and policies that aim to improve MCPR in urban areas. The results from this study underline the need to think about the context in the development, design, and evaluation of FP programs and/or policies.

Limitations and concluding remarks

Despite the evidence this study provided on the multilevel determinants of modern contraception in urban Nigeria, there are some limitations. First, the use of cross-sectional data did not allow for the estimation of causal relationships. Future studies should estimate causality through the use of longitudinal data to eliminate any form of endogeneity. Another limitation of this study is with the use of self-reported data, which has the potential for social desirability bias especially as sensitive sexual and reproductive health questions were asked. However, this bias is probably minimal since the interviews were conducted in private locations and by same-sex interviewers to ensure privacy and confidentiality. Furthermore, this study assumed that an urban cluster represents an urban community. This assumption may not hold and may be the reason no associations were found between modern method use and some of the variables at the community level. There is a need for further research to define what constitutes an urban community.

One way to do so may be through the use of social network analysis. Notwithstanding these limitations, the results of this study are pertinent to improving FP in urban Nigeria. The Nigerian Government, as reported in the 2014 FP Blueprint, proposes to increase CPR from 15% in 2013 to 36% by 2018 with the goal of averting 1.3 million infant and child deaths and 1.6 million unintended pregnancies [30]. To achieve this goal, access to and use of FP services should be on the forefront of the national health and development agenda. Programs should consider community factors in the design, implementation, and evaluation of their FP programs. Also, FP interventions should be multi-pronged and multi-level as those may be the best strategies to improve modern method use in diverse and densely-populated urban areas.

CHAPTER 4: EFFECTS OF GENDER-EQUITABLE NORMS ON MODERN CONTRACEPTION IN URBAN NIGERIA: A MULTILEVEL LONGITUDINAL STUDY

Overview

Background: Evidence suggests that gender equality positively influences reproductive health outcomes.

However, the evidence from urban Africa is sparse. This study aimed to examine the association between changes in gender-equitable norms and modern method use over time among women in urban Nigeria.

Methods: Data were collected in 2010/2011 from 16,118 women aged 15-49 living in six cities in Nigeria and again in 2014 from 10,672 of the same women. The analytical sample included 9,933 women living in 480 communities. A four-category outcome variable measured their change in modern method use within the study period. The exposure variables measured the changes in the level of gender-equitable attitudes towards: a) wife beating; b) household decisions; c) couples' family planning (FP) decisions; and d) FP self-efficacy. Multilevel multinomial logistic regression models estimated the associations between the exposure variables at the individual and neighborhood levels and modern method use.

Results: The proportion of women who reported use of modern methods increased from 21% to 32% during the four-year study period. At both surveys, 58% of the women did not report using modern methods while 11% reported using modern methods; 21% did not use at baseline but started using by endline while 10% used at baseline but discontinued by endline. A positive change in the gender-equitable attitudes towards household decisions, couples' FP decisions, and FP self-efficacy at the individual and neighborhood levels were associated with increased relative probability of modern method use (adoption and continued use) and decreased relative probability of modern method discontinuation by endline. No such associations were found between the individual and neighborhood attitudes towards wife beating and modern method use.

Conclusion: Interventions that promote gender equality have the potential to increase modern methods use in Nigerian cities.

Keywords: Gender Norms; Modern Contraception; Longitudinal Data; Multilevel Models; Urban Nigeria

Background

The fertility rate in Nigeria, the most populous country in Africa, remains high; a woman living in Nigeria is estimated to have 5.5 children during her lifetime [23]. A recent study estimated that about one-quarter of all pregnancies that occur in Nigeria annually are mistimed or unwanted at conception [13] and about one-half of these unintended pregnancies end in abortion [13]. Unintended pregnancy contributes significantly to maternal deaths through increased prevalence of unsafe abortions and/or complications during pregnancy [13, 109, 12]. According to the World Health Organization, Nigeria was the highest contributor to global maternal mortality in 2015 [2]. An estimated 58,000 maternal deaths occurred in 2015 giving a maternal mortality ratio (MMR) of 814 deaths per 100,000 live births [2]. To put these figures in perspective, the current lifetime risk of dying from a pregnancy-related cause is 1 in 22 in Nigeria compared to 1 in 3,800 and 1 in 5,800 in the United States of America and the United Kingdom, respectively [2]. A 2012 study revealed that about one in four maternal deaths in Nigeria were averted by family planning (FP) – a primary prevention strategy for maternal mortality [12]. In addition to preventing pregnancy-related morbidity and mortality, FP has been shown to improve women's empowerment through increased education and subsequent engagement in the workforce [7, 9, 19, 18].

Not all women who want to avoid a pregnancy are using effective contraceptive methods. According to the Nigeria Demographic and Health Surveys (NDHS), the contraceptive prevalence rate (CPR), that is the percentage of women aged 15-49 using contraception, has been on the rise since 1990; however, both the CPR and the rate of increase remain low. Among married women, the CPR increased from 6% in 1990 to 15% in 2013 [23, 24]. The majority of that increase was in the use of modern methods, which increased from 3.5% to 9.8% from 1990 to 2013. Most of that increase happened in the 1990s: 3.5% in 1990 to 8.6% in 1999 [24]. Since the 2000s, the CPR in Nigeria has stalled at about 10% for modern methods and 5% for traditional methods (i.e. withdrawal and periodic abstinence). Thus, there seems to be barriers to the practice of FP in Nigeria.

According to the 2008 NDHS, about 40% of married women who were not using a contraceptive method cited opposition to FP as their reason for not practicing contraception [62]. This opposition to FP

was disaggregated into opposition from the women (21%), male partners (10%), and others including religious institutions (9%). Sedgh & Hussian (2014) found similar results among Nigerian women with an unmet need for FP [156]. Stephenson et al. (2007) in their study of modern contraception in sub-Saharan Africa found that women were more likely to use modern methods if they perceived that other community members approved of FP [38]. Likewise, a study by Gueye et al. (2015) found that women who feared side effects and health risks of modern methods or who lived in communities where such fears were prevalent were less likely to report using a modern method [64]. Women in societies where women's status is low tend to have poor maternal health indices [38, 31, 72, 157]. These women often lack the power to make reproductive health decisions including FP use, seeking antenatal care, or delivering in a health facility [158-161]. Thus, women's empowerment has positive influences on women's health.

Gender equality and women's empowerment

The United Nations defines gender as the *“socially constructed roles and relationships, attitudes, behaviors, values, relative power, and influence that society ascribes to the two sexes on a differential basis”* [162]. Gender differs from sex (the biological and genetic characteristics of an individual) in that gender is acquired and varies over time, within, and across cultures. Attitudes towards gender roles and relationships, referred to as gender norms, operate at multiple levels of the socioecological system – individual, household, neighborhood, community, and society – leading to social conformity [157, 162]. In societies where the gender norms are inequitable towards women, women who do not conform to these norms often suffer adverse outcomes or disadvantages [163]. Inequitable gender norms may directly lead to negative health outcomes; for example, female circumcision, a sociocultural practice in Nigeria to curtail women's sexuality, has been shown to be associated with adverse obstetric outcomes such as severe bleeding during childbirth [164]. Additionally, inequitable gender norms indirectly influences health outcomes through women's lack of decision-making power. Improving gender-equitable norms can lead to women's empowerment, which in turn will improve their health and that of their families.

Women's empowerment continues to be a focus for global public health and development. At the turn of the millennium, United Nations member states signed the Millennium Declaration to achieve eight

Millennium Development Goals (MDGs) by 2015 among which included Goal 3 (promote gender equality and empower women) and Goal 5 (improve maternal health) [1]. By the 2015 deadline, the United Nations reported that many countries made progress towards achieving these goals; however, gender inequality and maternal mortality persisted especially among the poorest and most vulnerable populations [4]. A new set of goals to be achieved by 2030 – Sustainable Development Goals (SDGs) – were set at the end of 2015 to maintain the progress made during the MDG-era and to work towards ending the gender, wealth, and health inequalities [4]. More research is needed to better understand the pathways through which gender equality influences women's health. This study aimed to examine the relationships between changes in gender-equitable attitudes and changes in modern method use over time among reproductive-age women living in select Nigerian cities. Four dimensions of gender-equitable attitudes were assessed: attitudes towards wife beating, attitudes towards household decisions, attitudes towards couples' FP decisions; and attitudes towards FP self-efficacy.

Theoretical framework linking gender-equitable norms and use of modern contraception

This study was informed by the Theory of Gender and Power developed by Robert Connell in 1987 [103] and adapted by Wingood & DiClemente in 2000 [104]. The theory posits that three social structures (division of labor, division of power, and structure of cathexis) exist at the societal level and together shape the gendered relationships between men and women at the interpersonal and intrapersonal levels [103-105]. These three interrelated structures are preserved in society through sociocultural mechanisms that continuously segregate power and assign roles and responsibilities to the different genders. According to the Wingood & DiClemente adaptation of the theory, gender-based inequalities created by these three social structures at the societal and community levels lead to increased risk factors and behaviors among the lower status gender at the interpersonal and intrapersonal levels [104, 105]. These risk factors negatively affect the well-being of the affected gender. The division of labor describes the allocation of unequal educational and occupational opportunities to women in relation to men, limiting women's economic potential [104, 105, 165]. For example, women are constrained to institutions that cater to nurturing such as child care and domestic work. These types of work are often uncompensated or undercompensated leading to economic imbalance and inequalities –

leaving these women to rely on men for financial sustenance. As the economic inequality between men and women increasingly favors men, women experience more economic risk factors (e.g. inability to pay for health services), which then lead to adverse outcomes.

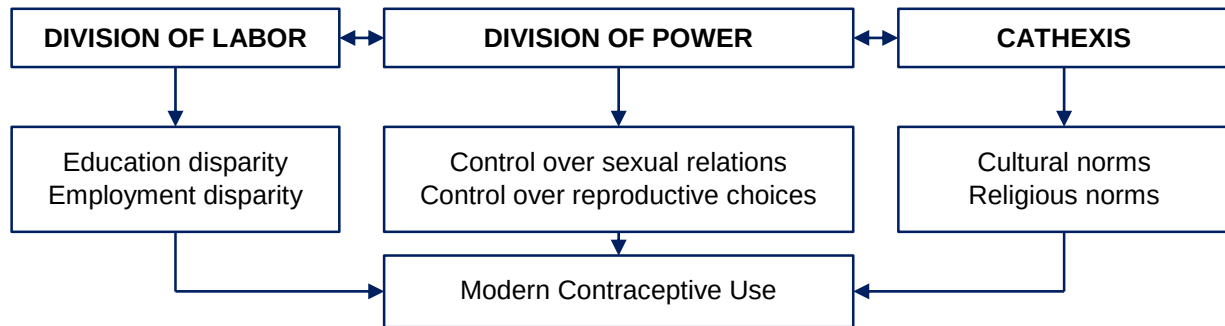
The division of power refers to the allocation of more power to one gender over the other. Power is defined in this context as the capability to influence one's actions and/or the actions of others [104]. In patriarchal societies, men exercise more power and control over their female partners, who may need to seek permission from the men to engage in any activity including leaving the house to visit family or friends. As the power inequality favoring men increases, women tend to experience more risk factors that predispose them to adverse outcomes [157]. For instance, a pregnant woman in labor waiting for the husband's permission to go to the hospital may delay receiving a medical intervention without which her health or that of her baby may be jeopardized. The structure of cathexis in this theory describes what the society deems as appropriate behaviors for men and women [104, 105]. In reproductive health, this social structure describes the cultural and religious norms that impose strict sexual roles and responsibilities on women (e.g. women should have sex to satisfy the desires of their male partners and for procreation, not for pleasure). This sexual gender inequality results in risky behaviors that negatively affect women's health, such as coerced sexual encounters that may lead to unintended pregnancies or sexually transmitted infections. All three structures are interrelated and together result in risk factors that increase the prevalence of adverse outcomes. For example, women who live in communities with religious and/or cultural restrictions on female sexuality (structure of cathexis) may be more likely to depend on their male partners for finances (division of labor) and may need permission from them to seek health services (division of power). Such women may experience increased economic, psychologic, and behavioral risk factors that endanger their health.

The Theory of Gender and Power was applied in this study to describe the relationships between the social structures and modern method use in urban Nigeria (*Figure 4.1*). Under the division of labor, it was hypothesized that women who experience gender inequality from educational and/or employment disparities will be unable to afford FP services if they desired to practice contraception. In this study, the

attitudes towards women's participation in household decisions were included to reflect inequalities under the division of labor. Researchers have documented that women who participate in household decision-making, a measure of economic empowerment, and those who are employed have higher odds of using modern methods compared to their less empowered counterparts [72, 158, 166, 71]. Under the division of power, it was hypothesized that women who lack authority over life choices such as reproductive choices or those who have experienced gender-based violence will be less empowered to make reproductive health decisions such as modern method use. The attitudes towards wife beating and attitudes towards couples' FP decisions were included in this study to reflect inequalities under the division of power. A recent study in southern Nigeria found that about two-thirds of both male and female study respondents did not support women having independent rights to contraceptive method choice, adoption, and use [75]. Without such rights, women were less likely to practice FP. Thus, under the structure of cathexis, women's attitudes towards their self-efficacy to FP use was hypothesized to positively influence the probability of modern method use.

A recent literature review of 60 studies from developing countries that examined the association between women's empowerment and fertility reported that the majority of the studies were from South Asia, relied on cross-sectional data, focused on married women, with only a handful of the studies accounting for the influence of the community-level women's empowerment on fertility [70]. This study fills the current gap in the literature by providing information on multiple levels of influence of gender norms on the use of modern methods from a longitudinal sample of both married and unmarried women living in urban areas of Nigeria. Given the multidimensionality of the factors under the three structures in the Theory of Gender and Power, multiple aspects of gender equality were assessed to provide a better contextual picture of the effects of gender norms on modern method use over time. This study hypothesized that women who hold gender-equitable attitudes, compared to those who do not, will have higher probability of adopting and/or continuing use of modern methods over time. Also, women who live in neighborhoods where other women hold gender-equitable attitudes will have a higher probability of adopting and/or continuing use of modern methods over time compared to those who live in neighborhoods where other women do not hold such gender-equitable attitudes.

Figure 4.1: The Theory of Gender and Power



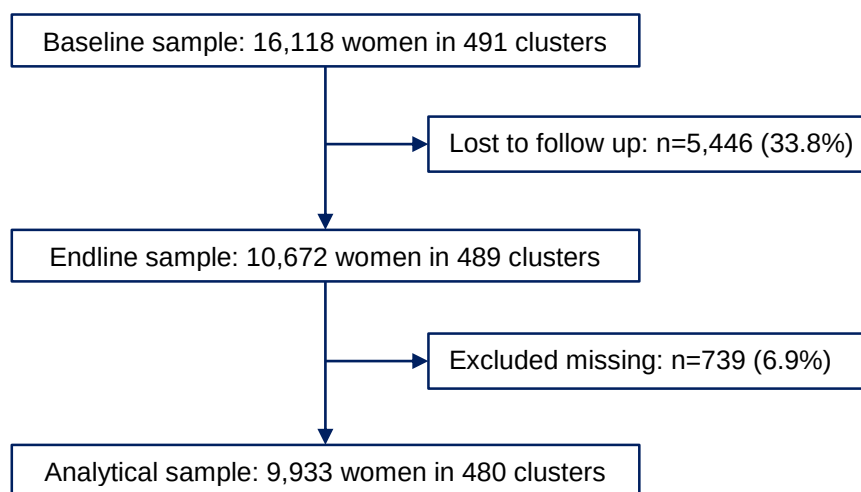
Methods

Study design and sample

This study used de-identified longitudinal data collected in Nigeria by the Measurement, Learning & Evaluation (MLE) project. The MLE project is the evaluation component of the Urban Reproductive Health Initiative. The Initiative is a multi-country FP program implemented in select urban areas in India, Kenya, Nigeria, and Senegal [140]. The program in Nigeria – Nigerian Urban Reproductive Health Initiative (NURHI) – aimed to increase the CPR in six purposively-selected cities: Abuja, Benin, Ibadan, Ilorin, Kaduna, and Zaria. To evaluate NURHI, the MLE project conducted longitudinal data collection at two-year intervals from 2010 to 2014. This study used baseline and endline data collected from a representative sample of reproductive-age women interviewed at baseline (2010/2011) and who were followed over the four-year period. The baseline sample of women was selected using a two-stage cluster sampling design. A sampling frame based on the most recent census in Nigeria (2006 census) was used to select a sample of enumeration areas. Enumeration areas are subdivisions of localities, which are the smallest administrative units. These enumeration areas were used as the primary sampling units and are hereafter termed clusters. In the first stage of sampling, a random sample of clusters was selected in each city. The number of clusters selected ranged from 74 in Zaria to 102 in Ibadan with a total of 491 clusters in the six cities. At the second stage of sampling, a random sample of 41 households was selected in each cluster. All women aged 15-49 years who resided in the selected households or were visitors present on the night before the survey were eligible to be interviewed.

The baseline women's survey was conducted between October 2010 and April 2011. A total of 16,144 women from about 16,000 households located in 491 clusters completed the baseline survey giving a 95% response rate. This baseline sample provided a representative sample of reproductive-age women in each city. Detailed information about the baseline women's survey is published elsewhere [148]. Four years after the baseline survey, the women who were not visitors to the households at the time of baseline survey were tracked and, if found, were re-interviewed during the endline survey. The women's endline survey was conducted in all cities between June and October 2014. Of the 16,118 eligible baseline women, 10,672 women in households located in 489 clusters were found and completed the endline interviews – giving a 66% response rate. About one-third of the women were lost to follow-up because they died, moved out of the study cities, or could not be found. Detailed information about the endline women's survey is published elsewhere [167]. For this study, the analytical sample was restricted to women aged 15-49 who were interviewed at both surveys. Women were excluded if they were aged more than 49 years at endline (n=592) or had missing data on any of the included variables (n=120). Clusters with fewer than five women were dropped (9 clusters with 27 women) as multilevel statistical models are known to provide reliable and valid estimates if the groups have at least five observations [150]. Thus, the analytical sample consisted of 9,933 women living in 480 clusters. The sample selection flowchart is shown in *Figure 4.2*.

Figure 4.2: Sample Selection Flowchart



Measures

Outcome variable

The outcome variable was a four-category variable indicating the change, or lack thereof, in use of modern methods between the two surveys. The modern method use variable was created from two sequential questions asked at both surveys: a) “are you (or your partner) currently doing something or using any method to delay or avoid getting pregnant?” and b) “which method(s) are you (or your partner) currently using?” Women were coded as having a value of ‘1’ if they responded ‘yes’ to the first question and, in response to the second question, chose any of these contraceptive methods: daily pill, injection, implant, intrauterine device, sterilization (female or male), diaphragm, emergency pill, spermicide (gels or foams), condom (male or female), and lactational amenorrhea. Women who did not answer affirmatively to the first question or did not choose any of the aforementioned methods for the second question were coded as having a value of ‘0’. Thus, women were recoded as ‘users’ or ‘non-users’ of modern methods at each of the surveys. A categorical outcome variable with four response options was then created to reflect the change, or lack thereof, in use of modern methods within the study period. The response options included the following groups of women: ‘non-users’, ‘users’, ‘adopters’, and ‘discontinuers’. The non-users were women who reported not using a modern method at both surveys while the users were women who reported using a modern method at both surveys. The adopters were women who reported not using a modern method at baseline survey but reported using a modern method at endline while the discontinuers were women who reported using a modern method at baseline but reported not using a modern method at endline survey.

Exposure variables

The exposure variables were norms measuring gendered attitudes towards: wife beating, household decisions, couples’ FP decisions, and FP self-efficacy [Table 4.1].

- Attitudes towards wife beating: During each survey, the women were asked whether they believed a husband is justified to beat his wife using seven scenarios: going out without telling him, neglecting the house or children, arguing with him, refusing to have sex with him, cooking food improperly, suspecting she is unfaithful, and refusing to have another child. The response options were

'yes', 'no', and 'don't know'. The Cronbach's alpha was 0.94 at baseline and 0.80 at endline. The responses were first dichotomized to '1' if the woman answered 'no' or '0' if she answered 'yes' or 'don't know'. The dichotomized responses were summed to scores ranging from 0 to 7. The higher the score, the more gender-equitable the attitudes towards wife beating.

- Attitudes towards household decisions: The women were also asked their opinions on who they thought should have a *greater say* in four scenarios: making small household purchases, making large household purchases, deciding when to visit family/friends, and when/where to seek medical care for their own health. The response options were 'husband', 'wife', 'both', and 'don't know'. The Cronbach's alpha was 0.84 at baseline and 0.68 at endline. The responses were first dichotomized to '1' if wife/both or '0' if husband/don't know. The dichotomized responses were summed to scores ranging from 0 to 4; increasing score reflects gender-equitable attitudes towards household decisions.

- Attitudes towards couples' FP decisions: This variable was created from responses to a set of nine statements to which the women were asked to state whether they agreed or disagreed. The statements included: a) the husband should be the one to decide whether the couple should use a FP /birth spacing/child spacing method; b) couples who practice FP have a better quality of life than those who do not; c) husbands and wives should discuss FP; d) men should not allow their wives to use FP; e) a woman who uses FP without her husband's knowledge should be punished; f) a woman who has no children is not complete/fulfilled; g) a man who has no children is not complete/fulfilled; h) a woman should continue bearing children until she has at least one son; and i) a woman should continue bearing children until she has at least one daughter. The Cronbach's alpha was 0.89 at baseline and 0.66 at endline. The responses to statements a, d-i were recoded to '1' if strongly disagree/disagree and '0' otherwise while the responses to statements b and c were recoded to '1' if strongly agree/agree and '0' otherwise. The dichotomized responses were summed to scores ranging from 0 to 9. The higher the score, the more gender-equitable the attitudes towards couples' FP decisions.

- Attitudes towards FP self-efficacy: The women were asked to state whether they agreed or disagreed with certain statements that assessed their perception about their ability to practice FP when they wanted. The statements were: you could start a conversation with your partner about FP; you could convince your partner that you should use a method of FP; you could get to a place where FP methods

are offered if you decided to use one; you could obtain a FP method if you decided to use one; you could use a FP method even if your partner doesn't want you to; you could use a method of FP if none of your friends or neighbors uses one; you could use a FP method even if your religious leader did not think you should use one; and you could continue to use a FP method if you experience some side effects. The Cronbach's alpha was 0.93 at baseline and 0.86 at endline. The responses were first dichotomized to '1' if strongly agree/agree or '0' if strongly disagree/disagree. The dichotomized responses were then summed to scores ranging from 0 to 8 with increasing score reflecting increasing FP self-efficacy.

The exposure variables were further categorized as '*low level*' or '*high level*' based on the median scores for each index at baseline. The baseline median scores for the gender-equitable attitudes towards wife beating, household decisions, couples' FP decisions, and FP self-efficacy were 7, 2, 6, and 5, respectively. Thus, the variables were dichotomized into 'low levels' if the score were lower or equal to the median scores and 'high levels' if higher than the median scores for all measures except for the gender-equitable attitudes towards wife beating score that was classified as 'low level' if the score was 0-6 or 'high level' if the score was equal to 7. These attitudes were also measured at the community level using a three-step method: 1) the individual scores were aggregated to the cluster level; 2) the index woman's score was subtracted from the cluster-level score; and then 3) the cluster-level score was divided by the number of women in that cluster minus one. The resultant community-level score represented the mean score for the gender-equitable attitudes of the other women in the same cluster. Just like the individual scores, the scores at the community-level were dichotomized into '*low level*' or '*high level*' based on the individual-level baseline median score. Finally, categorical variables measuring the change, or lack thereof, in the level of the gender-equitable attitudes between baseline and endline surveys were created for the individual and community levels. The categories included: '*low to low*', '*low to high*', '*high to low*', and '*high to high*' levels indicating the change from baseline to endline surveys.

Control variables

The baseline sociodemographic factors were included as control variables. The women's ages, which ranged from 15-49 years, were grouped into '15-24', '25-34', and '35-49' age groups and their

educational level were grouped into 'none/Quranic', 'primary', 'secondary', and 'higher' education. Religion was measured as Catholic, other Christian, Muslim, and no religion, which was recoded into 'Muslim' versus 'non-Muslim'. The number of children the women had ever born was categorized into 'none', '1-4', or '5 or more' children. The women's household wealth index was calculated using principal components analyses of several household items including, but not limited to, electricity, source of drinking water, toilet facility, land/livestock ownership, type of household building materials (*Appendix Table A1*). The weighted household index score was divided into quintiles (poorest, poor, middle, rich, and richest) and used as a proxy for household economic status. Marital/union status, which was measured as never married, currently married, living with a man, widowed, divorced, or separated was dichotomized into 'currently married or cohabiting' versus 'not currently married or cohabiting'. Since a change in union status is likely to be associated with a change in fertility intention, the union status variable was recoded into a categorical variable that reflected the change in status between surveys. The categories were 'never in-union', 'became in-union', and 'ever in-union'. The variable for the city of residence had six categories: Abuja, Benin, Ibadan, Ilorin, Kaduna, and Zaria. The choice of the functional forms of all the variables used in this study (continuous, categorical, or binary) were made based on the form that fit the data the best using model fit indices.

Table 4.1. List of variables used in the multilevel longitudinal analysis of modern method use	
Variable name	Description and response categories
Exposure variables	
Attitudes towards wife beating	This variable was measured using this set of questions: Sometimes a man is annoyed or angered by things that his wife does. In your opinion, is a man justified in hitting or beating his wife in the following situations? • If she goes out without telling him? • If she neglects the house or the children? • If she argues with him? • If she refuses to have sex with him? • If she cooks the food improperly? • If he suspects her of being unfaithful? • If she refuses to have another child? The response options were yes (1), no (2), and don't know (8). The scale's Cronbach's alpha was 0.94 at baseline survey and 0.80 at endline survey. Response to each question was dichotomized to '1' if no or '0' if yes/don't know. The dichotomized responses were summed to give scores ranging from 0 to 7; increasing score reflects gender equitable attitudes towards wife beating. The scores were further categorized into 'low' (score = 0-6) or 'high' (score = 7) based on baseline median value of seven.

Table 4.1 continued	
Attitudes towards household decisions	This variable was measured using this set of questions: In a couple, who do you think should have the greater say in each of the following decisions: the husband, the wife, or both equally? • Making large household purchases? • Making small daily household purchases? • Deciding when to visit family, friends, or relatives? • Deciding when and where to seek medical care for own health? The response options were husband (1), wife (2), both (3), and don't know (8). The scale's Cronbach's alpha was 0.84 at baseline survey and 0.68 at endline survey. Response to each question was dichotomized to '1' if wife/both or '0' if husband/don't know. The dichotomized responses were summed to give scores ranging from 0 to 4; increasing score reflects gender equitable attitudes towards women's participation in household decisions. The scores were further categorized into 'low' (scores = 0-2) or 'high' (scores = 3-4) based on baseline median value of two.
Attitudes towards couples' FP decisions	This variable was measured using this set of statements: • The husband should be the one to decide whether the couple should use a FP /birth spacing/child spacing method • Couples who practice FP have a better quality of life than those who do not • Husbands and wives should discuss FP • Men should not allow their wives to use FP • A woman who uses FP without her husband's knowledge should be punished • A woman who has no children is not complete/fulfilled • A man who has no children is not complete/fulfilled • A woman should continue bearing children until she has at least one son • A woman should continue bearing children until she has at least one daughter The response options ranged from strongly agree (1) to strongly disagree (4) with Cronbach's alpha 0.89 and 0.66 at baseline and endline surveys, respectively. The responses were dichotomized to '1' if strongly agrees/agrees with women's participation or '0' otherwise. The dichotomized responses were summed to give scores ranging from 0 to 9; increasing score reflects gender equitable attitudes towards women's participation in fertility decisions. The scores were further categorized into 'low' (scores = 0-6) or 'high' (scores = 7-9) based on baseline median value of six.
Attitudes towards FP self-efficacy	This variable was measured using this set of statements: • You could start a conversation with your partner about FP • You could convince your partner that you should use a method of FP • You could get to a place where FP methods are offered if you decided to use • You could obtain a FP method if you decided to use one • You could use a FP method even if your partner doesn't want you to • You could use a method of FP if none of your friends or neighbors uses one • You could use a FP method even if your religious leader did not think you should use one • You could continue to use a FP method if you experience some side effects The response options ranged from strongly agree (1) to strongly disagree (4) with Cronbach's alpha 0.93 and 0.86 at baseline and endline surveys, respectively. The responses were dichotomized to '1' if strongly agree/agree or '0' if strongly disagree/disagree. The dichotomized responses were summed to scores ranging from 0 to 8; increasing score reflects self-efficacy towards family planning use. The scores were further categorized into 'low' (scores = 0-5) or 'high' (scores = 6-8) based on baseline median value of five.

Table 4.1 continued	
Control variables	
Age	Baseline age groups: '15-24', '25-34', or '35-49' years
Parity	Baseline parity groups: '0', '1-4', '5 or more' children
Education	Baseline education categories: 'None/Quranic', 'Primary', 'Secondary', or 'Higher'
Union status	Baseline-Endline status: 'No->Yes', 'No->Yes, or 'Yes->Yes' in-union
Religion	Baseline religion: 'Muslim' or 'non-Muslim'
Household wealth	Baseline wealth quintile: 'Poorest', 'Poor', 'Middle', 'Rich', or 'Richest'
City of residence	Baseline city: 'Abuja', 'Benin City', 'Ibadan', 'Ilorin', 'Kaduna', or 'Zaria'
FP: Family planning	

Statistical Analyses

All statistical analyses were conducted in Stata version 14 and were weighted to account for the study design and non-response [151]. Descriptive analyses (proportion, mean, and standard deviation) were first conducted to provide information about the sociodemographic distribution of our study sample, together with the distribution of the exposure and outcome variables. Then, multilevel multinomial logistic models were run to test the associations between the individual and community gender-equitable attitudes and the modern method use pattern among our study sample. The rationale for using multilevel models was based on the hierarchical data structure (women nested in clusters) and the hypothesis that some effects will operate at the community level through peer influence. Multilevel models simultaneously run regression models for each data level taking into account the lack of independence of the nested observations and residuals. Additionally, multilevel models partition the variance in the outcome variable to that due to the individual versus community levels. For this study, the outcome variable was included at the individual level while the exposure variables were included at the individual and community levels. The control variables were also included at the individual level.

The multilevel modeling was conducted using a user-written Stata command 'gllamm' which stands for Generalized Linear Latent and Mixed Models. GLLAMM are a class of multilevel models that estimate fixed and random effects of various types of outcome variables including continuous, count, binary, ordered and unordered categorical variables [143-145]. In this study, two-level multinomial logistic models were run with discrete factor approximation, which give semi-parametric maximum likelihood estimators that were consistent and asymptotically efficient under the model assumptions [146]. A null

(intercept-only) model (Model 0; *Equation 4.1*) was run to test the null hypothesis that there was no between-cluster variation in the modern method use pattern during the study period. The response options for the outcome variables were ‘1’ non-user, ‘2’ adopter, ‘3’ discontinuer, and ‘4’ user. The base reference category for Model 0 was ‘1’ non-user. The within-cluster variance (σ^2) was standardized and fixed at the value of $\pi^{2/3}$ (≈ 3.29). The estimate from this model was used to calculate the proportion of the variance in the outcome variable that is attributable to the cluster level. This proportion is estimated by calculating the intra-cluster correlation coefficient (ICC), which in this study described the extent to which women in the same community were similar to each other relative to women in different communities.

$$P(Y_{ij} = k) = \gamma_{0j} + u_{0j} + e_{ij} \dots\dots\dots (\text{Equation 4.1})$$

Where: $P(Y_{ij} = k)$ = *estimated probability of outcome variable = k where k= outcome options 2, 3, or 4 for an individual ‘i’ in group ‘j’*

γ_{0j} = *group-specific intercept*

u_{0j} = *community-level random effects*

e_{ij} = *individual-level random effects*

Separate multivariate multilevel models containing the individual and community exposure variables together with the control variables were run for each of the four dimensions of gender-equitable attitudes. Model 1 (*Equation 4.2*), which included only the individual-level exposure and control variables was fitted to test their direct effects on the outcome variable.

$$P(Y_{ij} = k) = \gamma_{0j} + \beta X_{ij} + u_{0j} + e_{ij} \dots\dots\dots (\text{Equation 4.2})$$

Where: βX_{ij} = *coefficients of the individual-level exposure variables*

Finally, Models 2a-2c (Equations 4.4.1 – 4.4.3) were run to test the study hypotheses, which included:

- 1) Positive change in gender-equitable attitudes between surveys at both the individual and community levels are associated with increased probability of being a *user* versus *non-user* of modern method (*Equation 4.4.1*).

Model 2a: $P(Y_{ij} = 4/1) = \gamma_{0j} + \beta X_{ij} + \delta Z_j + u_{0j} + e_{ij} \dots\dots\dots (\text{Eq. 4.4.1})$

Where: 4/1 = *user compared to non-user*

δZ_j = *coefficients of the community-level exposure variables*

- 2) Positive change in gender-equitable attitudes between surveys at both the individual and community levels are associated with increased probability of being an *adopter* versus *non-user* of modern method (Equation 4.4.2).

$$\textbf{Model 2b: } P(Y_{ij} = 2/1) = \gamma_{0j} + \beta X_{ij} + \delta Z_j + u_{0j} + e_{ij} \dots\dots\dots (\text{Eq. 4.4.2})$$

Where: 2/1 = *adopter compared to non-user*

- 3) Positive change in gender-equitable attitudes between surveys at both the individual and community levels are associated with decreased probability of being a *discontinuer* versus *user* of modern method (Equation 4.4.3).

$$\textbf{Model 2c: } P(Y_{ij} = 3/4) = \gamma_{0j} + \beta X_{ij} + \delta Z_j + u_{0j} + e_{ij} \dots\dots\dots (\text{Eq. 4.4.3})$$

Where: 3/4 = *Discontinuer compared to User*

Since the coefficients from multinomial logistic models cannot be directly interpreted, post-estimation exponentiation of the coefficients was performed to produce relative risk ratios (RRR). The VIF assessed multicollinearity of variables and was found to be below the cut-off point of 10 in all models. Post-estimation goodness-of-fit tests were also conducted to assess how well the models fit the data. The Log Likelihood and Akaike Information Criteria (AIC) values of the models were compared. Likelihood Ratio (LR) tests comparing the full models to the null model and to the model containing only the individual-level exposure variables were also conducted.

Ethical approval

The ethical approval for the study was obtained from the Nigeria Health and Research Ethics Committee and the University of North Carolina at Chapel Hill Institutional Review Board. Verbal informed consent was obtained from all respondents prior to each round of study participation. Women who were aged less than 18 years (ages 15-17) were considered as emancipated minors and were able to provide consent. The interviewers documented the receipt of verbal informed consent on the individual consent forms. Upon receipt of informed consent, the women were interviewed by trained female interviewers using paper-and-pencil questionnaires at private locations within or close to their residence. This study used the de-identified public-use versions of the datasets.

Results

Sample characteristics

The sociodemographic characteristics of the women at baseline and endline surveys are shown in *Table 4.2*. The 9,933 women included in this study resided in households located in 480 clusters with a range of 5-63 women per cluster. The median number of women per cluster was 24. At baseline, 35% of the women were aged 15-24 years, 37% were aged 25-34 years, while 28% were aged 35-49 years. By endline, their ages increased by four years; consequently, the proportion aged 15-24 years decreased while those aged 25-34 and 35-49 years increased. About three-quarters of the women had secondary or higher education with about 10-12% reporting no formal education at both time points. Two-thirds of the women had ever been in-union (i.e. married or cohabited with a male partner) at baseline survey; the proportion increased to 72% four years later. During the study period, 26% of the women were never in-union, 63% were ever in-union, while 11% joined a union [data not shown]. One-half of the women were Muslims (54% and 51% at baseline and endline surveys, respectively) while the other half were mainly Christians with less than 1% at both time points reporting indigenous or no religious affiliation. About 34% of the women had no children at the baseline survey; this proportion decreased to 26% by the endline survey. The proportion of women with one to four children increased from 46% at baseline to 49% at endline; while the proportion with five or more children increased from 20% at baseline to 25% at endline. The proportions of the households grouped under the wealth quintiles at both time points were about the same as expected due to the method of calculation. The women resided in six cities with the highest proportion living in Kaduna (27%) and the lowest proportion living in Benin (11%) at baseline. There was minimal migration across the cities.

Table 4.2: Demographic factors of women aged 15-49 in six cities in Nigeria, 2010 to 2014		
	Baseline values	Endline values
Age in years, %		
15-24	35.0	23.1
25-34	37.1	38.5
35-49	27.9	38.4
Education, %		
None/Quranic	11.7	9.9
Primary	14.8	15.1
Secondary	50.6	43.5
Higher	22.9	31.5
Union status, %		
Ever in-union	65.2	71.5
Never in-union	34.8	28.5
Religion, %		
Muslim	53.5	50.7
Non-Muslim (Christian, traditional, none)	46.5	49.3
Parity, %		
0 child	33.9	26.0
1-4 children	46.1	49.1
5 or more children	20.0	24.9
Household wealth, %		
Poorest	16.6	19.0
Poor	18.8	19.5
Middle	20.4	20.5
Rich	22.6	21.0
Richest	21.6	20.0
City of residence, %		
Abuja	12.5	13.0
Benin	10.5	13.1
Ibadan	18.0	20.2
Ilorin	16.4	15.5
Kaduna	27.1	25.5
Zaria	15.5	12.7
Number of women	9,933	
Number of clusters	480	
Mean number of women per cluster (standard deviation)	26.7 (11.4)	
Median number of women per cluster (range)	24 (5-63)	

Table 4.3 shows the distribution of the exposure variables among the study sample measured at both the individual and community levels. For the gender-equitable attitudes towards wife beating, the scores ranged from 0 to 7 with increasing scores indicating intolerance towards wife beating. At the individual-level, the mean score increased from 6.0 to 6.6 from baseline to endline surveys and the proportion of women reporting high levels of the gender-equitable attitudes towards wife beating increased from 67% to 81% during the study period. At the community-level, the mean score increased from 5.5 to 6.1 from baseline to endline survey. The proportion of women in communities classified as

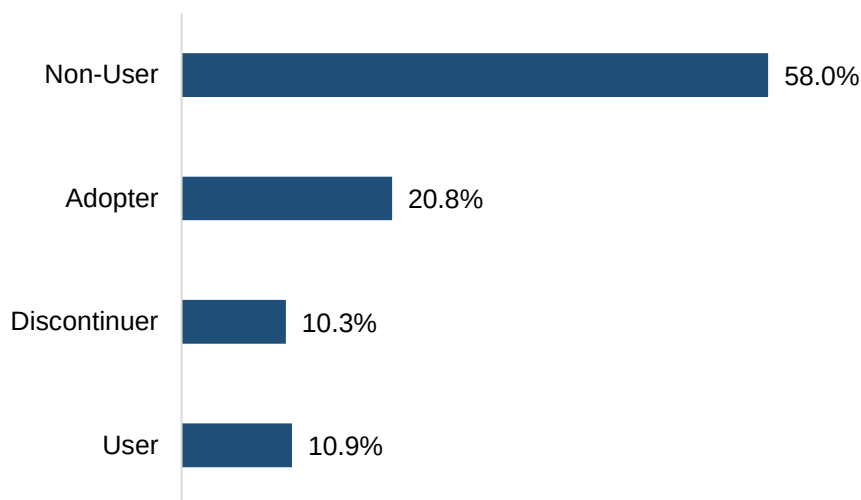
having high levels of gender-equitable attitudes towards wife beating also increased from 36% at baseline to 64% at endline. For the gender-equitable attitudes towards household decisions score (range: 0-4), the individual-level mean score increased from 2.0 to 2.5 while the community-level mean score increased from 1.9 to 2.3 within the study period. The proportion of women reporting high levels of the gender-equitable attitudes increased from 44% to 63% within the study period. Similar results were noted at the community-level where the proportion of women in neighborhoods classified as having high levels of gender-equitable attitudes towards household decisions increased from 51% to 73%.

The scores for the gender-equitable attitudes towards couples' FP decisions ranged from 0 to 9; the mean score increased from 5.7 to 6.7 at the individual-level and from 5.3 to 6.3 at the community-level. The proportion of women reporting high levels of gender-equitable attitudes towards couples' FP decisions increased from 40% at baseline to 58% at endline while the proportion of women who live in communities classified as having high levels of these gender-equitable attitudes increased from 29% at baseline to 66% at endline. Lastly, the scores of the gender-equitable attitudes towards FP self-efficacy ranged from 0 to 8; the higher the score the higher the FP self-efficacy. The individual-level mean score increased from 4.2 at baseline to 5.6 at endline while the community-level mean score increased from 3.9 at baseline to 5.2 at endline. The proportion of women reporting high levels of the gender-equitable attitudes towards FP self-efficacy increased from 44% to 66% within the study period; likewise, the proportion of women in communities classified as having high levels of these attitudes also increased 26% to 66% within the study period. The proportions of women reporting modern method use at both time points are also shown in *Table 4.3*. About 21% of the women reported using a modern method at baseline; by endline, this proportion increased to 32%. At baseline, the most commonly reported modern methods were male condoms (8.2%), injections (4.9%), daily pills (2.4%), intrauterine device (2.1%), lactational amenorrhea (1.6%), and emergency pills (1.2%); about 0.6% of the women reported using other modern methods including female or male sterilization, implants, female condoms, diaphragms, or spermicides. At endline, the commonly reported modern methods were male condoms (9.6%), injections (7.6%), lactational amenorrhea (3.4%), daily pills (3.3%), intrauterine device (2.9%), implants (2.6%), and emergency pills (1.6%); 1% reported using other modern methods.

Table 4.3: Distribution of exposure and outcome variables among study sample, 2010 to 2014		
	Baseline values	Endline values
Exposure variables		
<i>Individual-level norm, %</i>		
Gender-equitable attitudes towards wife beating		
Mean score (standard deviation)	6.0 (1.9)	6.6 (1.1)
Low level (score=0-6)	32.8	19.1
High level (score=7)	67.2	80.9
Gender-equitable attitudes towards household decisions		
Mean score (standard deviation)	2.0 (1.4)	2.5 (1.2)
Low level (score=0-2)	55.9	37.4
High level (score=3-4)	44.1	62.6
Gender-equitable attitudes towards couples' FP decisions		
Mean score (standard deviation)	5.7 (2.1)	6.7 (1.7)
Low level (score=0-6)	60.4	42.2
High level (score=7-9)	39.6	57.8
Gender-equitable attitudes towards FP self-efficacy		
Mean score (standard deviation)	4.2 (2.7)	5.6 (2.0)
Low level (score=0-5)	56.0	33.6
High level (score=6-8)	44.0	66.4
<i>Community-level norms, %</i>		
Gender-equitable attitudes towards wife beating		
Mean score (standard deviation)	5.5 (0.9)	6.1 (0.5)
Low level (score=0-6)	64.4	36.5
High level (score=7)	35.6	63.5
Gender-equitable attitudes towards household decisions		
Mean score (standard deviation)	1.9 (0.7)	2.3 (0.5)
Low level (score=0-2)	49.5	26.9
High level (score=3-4)	50.5	73.1
Gender-equitable attitudes towards couples' FP decisions		
Mean score (standard deviation)	5.3 (1.0)	6.3 (0.8)
Low level (score=0-6)	71.1	34.3
High level (score=7-9)	28.9	65.7
Gender-equitable attitudes towards FP self-efficacy		
Mean score (standard deviation)	3.9 (1.4)	5.2 (0.9)
Low level (score=0-5)	74.1	34.4
High level (score=6-8)	25.9	65.6
Outcome variable		
Modern method use, %		
Yes	21.0	31.7
No	79.0	68.3
FP: Family Planning		

Figure 4.3 shows the distribution of the modern method use pattern within the study period. At both surveys, 58% of the women did not report using modern methods (non-users) while 11% reported using modern methods (users); 21% did not use at baseline but started using by endline (adopters) while 10% used at baseline but discontinued by endline (discontinuers).

Figure 4.3: Modern method use pattern among study sample, 2010 to 2014



Relationships between gender-equitable attitudes and modern method use pattern

The associations between the gender-equitable attitudes and modern method use pattern between surveys were assessed using multilevel multinomial logistic models that included both the individual and community levels of the attitudes controlling for sociodemographic factors. The models estimated whether the change, or lack thereof, in the gender-equitable attitudes between surveys were associated with varying modern method use patterns. However, only the following comparisons are presented: a) using a modern method compared to not using a modern method at both surveys (i.e. users versus non-users); b) adopting a modern method between surveys compared to not using a modern method at both surveys (i.e. adopters versus non-users); and c) discontinuing a modern method between surveys compared to using a modern method at both surveys (i.e. discontinuers versus users). The multilevel results are discussed below.

Gender-equitable attitudes towards wife beating and modern method use pattern

Table 4.4 shows the estimates from the multilevel models of gender-equitable attitudes towards wife beating on modern method use pattern. No significant associations were observed between the individual-level and/or community-level attitudes towards wife beating and modern method use pattern.

Table 4.4: Gender-equitable attitudes towards wife beating and modern contraception			
	User vs. Non-User	Adopter vs. Non-User	Discontinuer vs. User
	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)
Individual-level attitudes			
Low to Low	ref	ref	ref
Low to High	0.98 (0.70-1.37)	1.16 (0.92-1.47)	0.97 (0.64-1.48)
High to Low	1.06 (0.73-1.55)	1.10 (0.84-1.44)	1.15 (0.72-1.85)
High to High	1.12 (0.81-1.55)	1.12 (0.89-1.41)	0.97 (0.65-1.46)
Community-level attitudes			
Low to Low	ref	ref	ref
Low to High	0.97 (0.78-1.20)	0.97 (0.82-1.15)	0.89 (0.69-1.14)
High to Low	1.19 (0.84-1.69)	1.11 (0.84-1.47)	0.72 (0.46-1.11)
High to High	0.92 (0.73-1.16)	0.98 (0.82-1.18)	1.10 (0.84-1.45)
RRR: Relative Risk Ratio; CI: Confidence Interval; *p<0.05; **p<0.01; ***p<0.001; Models included individual and community exposure variables controlling for age, education, marital history, religion, parity, household wealth, and city			

Gender-equitable attitudes towards household decisions and modern method use pattern

Table 4.5 shows the estimates from the multilevel models of gender-equitable attitudes towards household decisions on modern method use pattern. At the individual-level, having high levels of gender-equitable attitudes towards household decisions at baseline (i.e. switching from low to high levels or remaining at high levels compared to remaining at low levels) increased the relative probability of using a modern method at both surveys compared to not using a modern method at both surveys (RRR: 1.38-1.60; $p<0.01$). Similarly, having high levels of gender-equitable attitudes towards household decisions at baseline increased the relative probability of adopting a modern method between surveys compared to not using a modern method at both surveys (RRR: 1.17-1.23; $p<0.05$). On the other hand, having high levels of gender-equitable attitudes towards household decisions compared to having low levels at both time points decreased the relative probability of discontinuing a modern method between surveys compared to using a modern method at both time points (RRR: 0.73; 95% CI: 0.55-0.98). A negative change in the gender-equitable attitudes towards household decisions (high to low levels) at the individual-level was not significantly associated with modern method use pattern ($p>0.05$).

Controlling for the individual-level values, community-level attitudes were also associated with modern method use pattern between surveys. Compared to women who lived in communities that had low levels of gender-equitable attitudes towards household decisions at both time points, those who lived in communities that had high levels of gender-equitable attitudes at baseline had higher relative

probabilities of using a modern methods at both surveys (RRR: 2.28-2.66; $p<0.01$) or adopting a modern method between surveys (RRR: 1.28-1.58; $p<0.05$) as opposed to not using a modern method at both surveys. Women who lived in communities that started out at high levels but switched to low levels by baseline also had higher relative probabilities of being modern method users and adopters compared to being non-users between surveys (RRR: 2.00-2.23; $p<0.001$). However, living in communities that had positive changes in the levels of gender-equitable attitudes towards household decisions compared to living in neighborhoods that remained at low levels at both time points decreased the relative probabilities of discontinuing modern methods between the surveys compared to using modern methods at both surveys (RRR: 0.54-0.58; $p<0.05$).

Table 4.5: Gender-equitable attitudes towards household decisions and modern contraception			
	User vs. Non-User	Adopter vs. Non-User	Discontinuer vs. User
	exp(β) (95% CI)	exp(β) (95% CI)	exp(β) (95% CI)
Individual-level attitudes			
Low to Low	ref	ref	ref
Low to High	1.38 (1.09-1.75)**	1.17 (1.02-1.36)*	0.81 (0.60-1.09)
High to Low	1.24 (0.93-1.64)	1.03 (0.85-1.24)	0.88 (0.62-1.24)
High to High	1.60 (1.26-2.03)***	1.23 (1.05-1.45)*	0.73 (0.55-0.98)*
Community-level attitudes			
Low to Low	ref	ref	ref
Low to High	2.28 (1.61-3.23)***	1.28 (1.03-1.61)*	0.58 (0.38-0.89)**
High to Low	2.23 (1.36-3.67)***	2.00 (1.38-2.89)***	0.72 (0.40-1.30)
High to High	2.66 (1.88-3.76)***	1.58 (1.24-1.99)***	0.54 (0.35-0.82)**
RRR: Relation Risk Ratio; CI: Confidence Interval; * $p<0.05$; ** $p<0.01$; *** $p<0.001$; Models included individual and community exposure variables controlling for age, education, marital history, religion, parity, household wealth, and city			

Gender-equitable attitudes towards couples' FP decisions and modern method use pattern

Table 4.6 shows the estimates from the multilevel models of gender-equitable attitudes towards couples' FP decisions on modern method use pattern. Both the individual-level and community-level gender-equitable attitudes were associated with the modern method use pattern. Specifically, compared to women whose gender-equitable attitudes towards couples' FP decisions remained low during the study period, those whose attitudes changed from low to high levels had higher relative probability of adopting a modern method between surveys as opposed to not using a modern method at both surveys (RRR:1.37; 95% CI: 1.19-1.57). Women who remained at high levels compared to those that remained at low levels during the study period had higher relative probability of adopting a modern method between surveys or

using a modern method at both surveys as opposed to not using modern methods at both surveys (RRR: 1.54-2.34; $p<0.001$); these women also had lower relative probability of discontinuing a method during the study period (RRR: 0.73; 95% CI: 0.55-0.97). Switching from high to low levels compared to remaining at low levels at both time points was associated with higher relative probability of using a modern method compared to not using a modern method at both surveys (RRR: 1.49; 95% CI: 1.16-1.91). No such associations were observed for adopter versus non-user status or discontinuer versus user status for the women that had negative changes ($p>0.05$).

Additionally, controlling for the individual-level attitudes, women who lived in communities that remained at high levels compared to low levels at both time points had higher relative probability of using a modern method compared to not using a modern method at both surveys (RRR: 1.47; 95% CI: 1.13-1.90) and lower relative probability of discontinuing a modern method between surveys versus using a modern method at both surveys (RRR: 0.62; 0.45-0.84). Likewise, women who lived in communities that switched from low to high levels compared to those who remained at low levels had lower relative probability of discontinuing a modern method between surveys versus using a modern method at both surveys (RRR: 0.72; 95% CI: 0.55-0.95). Living in communities that switched from high to low levels as compared to communities that remained at low levels did not significantly affect the relative probability of being a modern method user, adopter, or discontinuer during the study period ($p>0.05$).

Table 4.6: Gender-equitable attitudes towards couples' FP decisions and modern contraception			
	User vs. Non-User exp(β) (95% CI)	Adopter vs. Non-User exp(β) (95% CI)	Discontinuer vs. User exp(β) (95% CI)
Individual-level attitudes			
Low to Low	ref	ref	ref
Low to High	1.13 (0.91-1.41)	1.37 (1.19-1.57)***	1.04 (0.78-1.38)
High to Low	1.49 (1.16-1.91)**	1.01 (0.83-1.22)	1.18 (0.87-1.61)
High to High	2.34 (1.87-2.93)***	1.54 (1.31-1.82)***	0.73 (0.55-0.97)*
Community-level attitudes			
Low to Low	ref	ref	ref
Low to High	1.15 (0.92-1.45)	1.10 (0.93-1.31)	0.72 (0.55-0.94)*
High to Low	1.38 (0.92-2.05)	1.16 (0.83-1.62)	0.90 (0.57-1.42)
High to High	1.47 (1.13-1.90)**	1.12 (0.90-1.39)	0.62 (0.45-0.84)*
RRR: Relative Risk Ratio; CI: Confidence Interval; * $p<0.05$; ** $p<0.01$; *** $p<0.001$; Models included individual and community exposure variables controlling for age, education, marital history, religion, parity, household wealth, and city			

Gender-equitable attitudes towards FP self-efficacy and modern method use pattern

As shown in *Table 4.7*, the individual-level gender-equitable attitudes towards FP self-efficacy was associated with modern method use pattern during the study period. Women whose levels of gender-equitable attitudes changed from low to high levels compared to those who remained at low levels at both time points had higher relative probability of using modern methods at both surveys (RRR: 3.33; 95% CI: 2.42-4.60) or adopting modern methods between surveys (RRR: 2.37; 95% CI: 2.03-2.78) compared to not using modern methods at both surveys. These women also had lower relative probability of discontinuing a modern method between surveys compared to using a modern those at both surveys (RRR: 0.42; 95% CI: 0.28-0.63). Similar associations were observed among women whose attitudes remained at high levels as opposed to low levels at both time points. Interestingly, women who started off at high levels of the attitudes but changed to low levels by endline also had higher relative probabilities of using modern methods at both surveys (RRR: 3.14; 95% CI: 2.18-4.53) or adopting modern methods between surveys (RRR: 1.41; 95% CI: 1.14-1.74) compared to not using modern methods at both surveys. No significant difference was observed among these women for discontinuing a modern method compared to using a modern method at both time points (RRR: 1.07; 95% CI: 0.70-1.64).

The community-level attitudes towards FP self-efficacy were only associated with user versus non-user status but not with adopter versus non-user status or discontinuer versus user status. Specifically, irrespective of their own attitudes, women who lived in communities that remained at high levels had higher relative probability of using a modern method compared to not using a modern method at both surveys (RRR: 1.38; 95% CI: 1.06-1.79) as opposed to women who lived in communities that remained at low levels at both surveys. Also, compared to women who lived in communities that remained at low levels, women who lived in communities that switched from high to low levels had lower relative probability of using modern methods compared to not using modern methods at both time points (RRR: 0.54; 95% CI: 0.32-0.93). Other associations were not statistically significant ($p>0.05$).

Table 4.7: Gender-equitable attitudes towards FP self-efficacy and modern contraception			
	User vs. Non-User exp(β) (95% CI)	Adopter vs. Non-User exp(β) (95% CI)	Discontinuer vs. User exp(β) (95% CI)
Individual-level attitudes			
Low to Low	ref	ref	ref
Low to High	3.33 (2.42-4.60)***	2.37 (2.03-2.78)***	0.42 (0.28-0.63)***
High to Low	3.14 (2.18-4.53)***	1.41 (1.14-1.74)**	1.07 (0.70-1.65)
High to High	8.24 (6.02-11.27)***	2.91 (2.44-3.45)***	0.43 (0.30-0.63)***
Community-level attitudes			
Low to Low	ref	ref	ref
Low to High	1.12 (0.88-1.43)	1.10 (0.91-1.32)	1.11 (0.83-1.49)
High to Low	0.54 (0.32-0.93)*	1.01 (0.67-1.15)	1.60 (0.86-2.94)
High to High	1.38 (1.06-1.79)*	1.13 (0.91-1.40)	0.91 (0.66-1.25)
RRR: Relative Risk Ratio; CI: Confidence Interval; *p<0.05; **p<0.01; ***p<0.001; Models included individual and community exposure variables controlling for age, education, marital history, religion, parity, household wealth, and city			

The estimated between-cluster variations from all the models were used to calculate the ICC and the proportion of the variation explained by each of the full models (*Table 4.8*). With an estimated community-level variance of 0.45 from the null model, the calculated ICC was 0.12 meaning that 12% of the variance in the pattern of modern method use in this study was explained by the variation between communities. The residual between-cluster variance for the models with each of the four gender-equitable attitudes ranged from 0.17 to 0.20 – decreasing from 0.45 in the null model. Likewise, the ICC from the full models decreased from 0.12 to 0.05-0.06. These reductions implied that the variables included in the models explained about 55-61% of the variation between communities as it pertains to the modern method use pattern in this study.

Table 4.8: Parameters from multilevel models of modern method use pattern					
	Null model	Attitudes towards wife beating	Attitudes towards in household decisions	Attitudes towards FP and fertility	Attitudes towards FP self-efficacy
Community-level variance	0.44	0.20	0.17	0.20	0.17
Proportion explained by model	Reference	0.55	0.61	0.55	0.61
Intra-class correlation	0.12	0.06	0.05	0.06	0.05
Log-likelihood	-10395.1	-9730.5	-9707.2	-9664.6	-9464.9
Akaike Information Criteria	20804.2	19625.0	19578.4	19493.3	19093.8
Likelihood Ratio test	Reference	1329.2***	1375.9***	1460.9***	1860.4***
*** p<0.001; FP: Family Planning					

Discussion and Conclusion

The global mandate to ensure gender equality and to improve women's health is evident in their inclusion as SDG to be achieved by 2030. The United Nations states that both gender equality and FP are basic human rights and have the potential to improve women's health [4]. Empirical evidence that support this mandate is sparse especially in sub-Saharan Africa where maternal health indices remain poor. In addition, the rapid urbanization occurring in Nigeria and all of sub-Saharan Africa highlights the importance of understanding the role gender norms play in women's contraceptive behavior in urban contexts. This study provides evidence that gender norms are associated with modern method adoption, continuation, and discontinuation in urban Nigeria. This study found that the prevalence of modern method use increased by about 11 percentage-points over the four-year study period. Also, the proportion of women reporting high levels of the gender-equitable attitudes increased within the study period at both the individual and community levels. Significant associations were found between the gender-equitable attitudes and modern method adoption, continuation, and discontinuation. This evidence is relevant as it supports the hypothesis that gender equality contributes to women's health.

Looking closely at the dimensions of gender norms assessed, this study found no significant associations between the individual and community levels of gender-equitable attitudes towards wife beating and modern method use pattern. This finding was surprising as previous studies found significant associations between tolerant attitudes towards wife beating and modern method use and even with other maternal health services in sub-Saharan Africa including Nigeria [72, 166, 168, 74]. This discrepancy could be explained by the fact that this study used longitudinal data from urban women unlike previous studies that have mainly used cross-sectional data and/or included both urban and rural women in their analyses. Additionally, other studies measured attitudes towards wife beating using four scenarios, which were a subset of the seven scenarios used in this study. Although the proportion of women who reported intolerant attitudes towards wife beating at baseline was similar to what was found in previous studies that used only cross-sectional data (about 60%) [166, 92, 169]; this study found that by endline the proportion reporting intolerant attitudes towards wife beating became almost universal at 81%. This universality may also be a reason no significant associations with modern method use pattern were found. Additionally, the

attitudes towards wife beating may have direct effects on the experience of intimate partner violence more so than on modern method use. Previous studies found mixed results on the association between the experience of gender-based violence (intimate partner violence) and modern method use. Some studies found positive associations [170, 171] while others found negative associations [172]. It could be that the different forms of intimate partner violence (sexual, physical, or emotional violence) have varying effects on modern method use. Thus, further research is needed to delineate the causal pathways between intimate partner violence (both attitudes and/or experience) and modern method use.

This study also found that gender-equitable attitudes towards household decisions were positively associated with adoption and continued use of modern methods at both the individual and community levels. This finding supports the current evidence on the effects of having household decision-making power on women's health [72, 158, 166, 168, 74, 170]. In addition, this study provides evidence that having a positive increase in and/or remaining at high levels of gender-equitable attitudes towards women having household decision-making power is associated with modern method adoption and continued use over time. Further, irrespective of personal beliefs, living in communities with high levels of these gender-equitable attitudes is positively associated with modern method adoption and continued use, and negatively associated with modern method discontinuation over time. In addition to the favorable influence of having household decision-making power on modern method use, this study found that women who believe that men and women should have control over their decision to practice FP had higher probability of modern method adoption and continued use and lower probability of modern method discontinuation. Similar results were also observed among women who live in communities that held such beliefs. Last but not the least, this study supports previous findings that women's FP self-efficacy is positively associated with use of modern methods [35, 69, 68].

This study is not without limitations. The first limitation is based on how urban community was defined. Although previous studies used census enumeration areas (clusters) as communities in the study of contextual effects on reproductive health outcomes [36, 37, 39, 79], the assumption that these clusters are appropriate proxies for urban communities may be unfounded. The census clusters often

consist of local communities in rural areas and usually a block of households in urban areas. These clusters are typically not of equal sizes or boundaries. The use of these clusters may be appropriate in rural areas where people living in the same local community are related and/or have many characteristics in common. However, this may not be the case in urban areas where individuals come from diverse backgrounds and cultures. Urban residents may interact with people in the same office or school more than their neighbors. The lack of associations between some of the community-level attitudes and modern method use pattern could be a result of this lack of connectivity. Future research should focus on understanding what a '*community*' means in urban contexts.

Another limitation of this study was the proportion of the sample lost to follow-up; about one-third of the baseline sample was not re-interviewed at endline. A sensitivity analysis showed that unmarried and younger women were more likely to be lost to follow-up. Thus, it is possible that the associations found in this study may be different for these women. More analyses may be required to understand the effects of contextual factors on sub-populations based on age, marital status, or educational attainment to help inform the role of this loss to follow-up. Additionally, this study used data from two time points in a four-year period in assessing the modern method use pattern. The contraceptive use pattern in this time-period could be more complex than was observed; for example, the non-users may have used at some point in the study period but not at the time of the endline survey. The use of the FP calendar data is likely to be more appropriate in assessing such patterns.

In spite of these limitations, the results of this study adds to existing literature on the effects of gender norms on women's health. Inequitable gender norms act as social constraints that decrease women's ability to engage in healthy reproductive behaviors and/or seek services for their reproductive health needs. Thus, FP programs that incorporate actions or components geared towards ensuring gender equality, or promoting gender-equitable norms, are likely to see increases in the proportion of women who adopt modern methods and decreases in the proportion that discontinue modern methods. According to Keheler & Franklin (2008), such interventions can be implemented at the level of the individual (downstream intervention), community (midstream intervention), or population (upstream

intervention) [157]. A combination of interventions at multiple levels is likely to produce synergistic program effects and may work better in communities where gender inequality exists. The downstream intervention may involve reaching women in the homes, at their workplace, or within their communities through the use of community health workers or peer educators. The midstream intervention may entail community advocacy and/or media campaigns. Evaluation of previous media campaigns on FP use in some Nigerian cities showed positive effects on attitudes towards use and adoption of modern methods [40, 115]. Thus, including female empowerment messaging in such campaigns has the potential to increase gender-equitable norms, which will in turn, improve modern method use. Strategies for national (upstream) interventions may include policies to increase female education and economic empowerment, and/or reduce gender-based practices that harm women (e.g., violence against women, female genital mutilation). Thus, there is a need to develop, implement, and evaluate multi-strategy programs that combine all three levels of interventions aimed at eliminating gender inequality in Nigeria.

CHAPTER 5: CONCLUSION

Recent estimates project that the world population will grow to 9.8 billion by 2050 with the majority of the growth occurring in urban areas [118, 132]. Approximately one-half of the world population currently live in urban areas; Africa and Asia, as compared to the other world regions, have the highest urbanization rates [118]. The urbanization rates in these developing regions are said to be driven by high fertility rates more so than internal migration [95, 119, 120]. Currently, urban development lags behind urban population growth contributing to the sprouting of urban slums with poor access to basic amenities. One way to control the rate of urbanization is through the practice of FP. In addition to helping women and couples attain their desired family size, FP has other benefits including reduction in maternal and child mortality rates through prevention of high-risk pregnancies, women's empowerment through education and employment, and environmental sustainability through population control [7, 9, 10, 19, 20].

This dissertation aimed to further the understanding of factors that influence the practice of FP in urban areas of Nigeria – one of the three countries projected to account for one-third of the additional 2.5 billion urban population by 2050. This dissertation was guided by the Socioecological Framework and two behavioral theories – Social Cognitive Theory and Theory of Gender and Power. Using multilevel statistical regression models, cross-sectional and longitudinal data from reproductive-age women (15-49 years) living in six urban areas in Nigeria were used to explore the associations between socioecological factors and the use of modern methods through two distinct studies. Findings from these studies provide evidence that may be relevant to FP programs and policies in urban areas of Nigeria.

Summary of Findings

Study 1 used baseline data from a household-based women's survey and facility-based surveys to estimate the direct and interaction effects of intrapersonal, interpersonal, institutional, community, and societal factors on the use of modern methods. The results of this study were as follows:

- Intrapersonal factors were associated with modern method use. Urban women who were aged 25 or older, had more than secondary education, not married or cohabiting with a male partner, had at least one living child, or were employed had higher odds of using modern methods. On the contrary, urban women who are Muslims, resided in the wealthiest households, or reported no or low self-efficacy towards FP use had lower odds of using modern methods.
- Interpersonal factors were associated with modern method use. Urban women who reported having discussions about their fertility desires with their male partners had a higher odds of modern method use while those who perceived their neighbors and friends would stigmatize their use of FP had lower odds of modern method use.
- Access to FP services in nearby health facilities, pharmacies, or drug stores was not associated with modern method use. The odds of urban women using modern methods did not differ according to their level of access to FP services in facilities located within one-kilometer radius of their community of residence.
- Community and city characteristics were associated with modern method use. Although living in poor communities or communities with large family size norms did not increase or decrease their odds of using modern methods, urban women who lived in neighborhoods that were exposed to FP messages in the media had higher odds of using modern methods. Additionally, compared to women in Abuja, those who live in Benin (a southern city) and those who live in two northern cities (Kaduna and Zaria) had lower odds of using modern methods. The odds of using modern methods did not differ for women living in Ibadan or Ilorin (two southwestern cities) as compared to those who live in Abuja.
- Community characteristics modified associations between individual characteristics and modern method use. The characteristics of the community significantly influenced the urban women's odds of using modern methods. Urban women who lived in communities with a high prevalence of modern method use had higher odds of using modern methods compared to those who lived in

neighborhoods with a low prevalence of modern method use. As stated earlier, urban women who had children had higher odds of using modern methods compared to those who did not have children. However, in communities where large family size was the norm, the reverse was the case as urban women who had children had lower odds of modern method use compared to their counterparts with no children. Also, the magnitude of the effect of being employed on modern method use was higher for urban women who lived in poor communities more so than for those who lived in non-poor communities. The implications of these findings are discussed later in this Chapter.

Study 2 used longitudinal data from the household-based women's survey to estimate the effects of individual and community gender-equitable norms on modern method use patterns among reproductive-age women living six cities in Nigeria. The results of this study were as follows:

- Urban women's attitudes towards wife beating at the individual and community levels did not influence their adoption, continuation, discontinuation, or non-use of modern methods over time. The prevalence of justifiable attitudes towards wife beating among urban women over the four-year study period was very low in this study. As such, it was not surprising that the change in attitudes towards wife beating did not significantly influence the pattern of use of modern methods.
- Urban women's attitudes towards women's participation in household decisions at the individual and community levels influenced the adoption, continuation, discontinuation, or non-use of modern methods over time. Specifically, at the individual-level, a positive change in the gender-equitable attitudes towards women's participation in household decisions increased the relative probability of modern method adoption and continuation, and decreased the relative probability of modern method discontinuation. Likewise, having lived in a community that had gender-equitable attitudes towards women's participation in household decisions at some point in the study period increased the relative probability of modern method adoption and continuation, and decreased the relative probability of modern method discontinuation over time.
- Urban women's attitudes towards women's participation in fertility decisions at the individual and community levels influenced their adoption, continuation, discontinuation, or non-use of modern methods over time. Having gender-equitable attitudes towards women's participation in couples'

FP decisions at some point during the study increased the relative probability of modern method adoption and continuation, and decreased the relative probability of modern method discontinuation. Similar results were also observed at the community-level as living in communities with gender-equitable attitudes towards women's participation in FP decisions at some point during the study increased the relative probability of modern method adoption and continuation, and decreased the relative probability of modern method discontinuation over time.

- Urban women's attitudes towards FP self-efficacy at the individual level, but not at the community-level, influenced their adoption, continuation, discontinuation, or non-use of modern methods over time. Specifically, at the individual-level, having positive attitudes towards FP self-efficacy at any point within the study period increased the relative probability of modern method adoption and continuation, and decreased the relative probability of modern method discontinuation. However, the community-level attitudes towards FP self-efficacy did not influence the adoption, continuation, discontinuation, or non-use of modern methods over time.

Implications for FP Programs and Policies

The Nigerian government aims to increase the CPR to 36% by 2018 (from 15% in 2013). The recent FP blueprint recognizes the need for a multi-pronged strategy that will address six thematic areas: demand generation and behavior change communication; service delivery; supplies and commodities; policy and environment; financing; and supervision, monitoring, and coordination [30]. This dissertation provides evidence that is likely to inform and support FP programs and policies in Nigeria, hereafter referred to as FP interventions. One of the key contributions of this dissertation is that it highlighted the importance of considering the context in which a FP intervention is to be implemented. FP interventions should consider how the physical, social, economic, and health environments/systems would affect their expected outcomes. Such interventions should be multifaceted and implemented at the individual and community levels to simultaneously address the numerous deterrents of modern method use, which occur concurrently and do not exist in isolation. Understanding the needs of the target population through the use of primary or existing data is essential to the success of any such intervention as it will help delineate at-risk individuals and populations. Focusing resources to these populations is likely to lead to

the achievement of the desired outcomes, such as increasing the MCPR in urban communities in Nigeria. The women and communities that likely need more focused attention in urban Nigeria, as identified in this dissertation, are discussed below.

FP interventions at the individual-level

Interventions at the individual-level should aim to increase adoption and continued use of modern methods among these sub-groups of urban women:

Young women. Urban women aged 15-24 years had lower odds of using modern methods compared to those aged 25-49. Nigeria, currently, has a young population with 20% of the 182 million populace aged 15-24 years and 43% aged 0-14 years. Hence, targeting FP interventions at these young women is essential to controlling fertility in Nigeria. Interventions should find innovative ways to provide youth-friendly FP services to encourage the use of modern methods and minimize the potential for stigma faced by many young women in adult maternal health service facilities. Also, adopting modern method use at a young age is likely to foster a positive lifelong contraceptive behavior; thus, these women will likely reap the benefits of FP over a longer period of their reproductive years. Although it is possible that young women, especially those who are married, desire to procreate, it is still necessary that they are reached with FP messages so that they know when and where to seek FP services if needed. One way to reach young women with FP messages is through mass media. A recent study among young women in urban Nigeria found that the major media sources of FP messages were mobile phones, radio, and television and that those who were exposed to FP messages via those media tools were more likely to report using modern methods [173]. An FP media campaign may help in generating demand for FP through providing information on the different methods, their mechanisms of action, efficacy and side effects, and also dispel the misconceptions about the different types of contraceptive methods. There may be a need to emphasize long-acting reversible modern methods such as implants and intrauterine devices, especially for young women who do not intend to get pregnant in the near future. Such FP media campaigns need not stand alone, they can be integrated into other ongoing health campaigns. These types of media campaigns have the potential to reach broader audiences, including in-school and out-of-school youth, and may have larger impacts on the MCPR among this population.

Additionally, interventions aimed at improving the educational attainment of these women is likely to increase their use of modern methods as many studies have found positive associations between women's education and use of modern methods. Evidence from this dissertation supports previous studies that found that tertiary education has a strong positive effect on modern method use [25, 26, 38, 44]. This finding is especially true in urban areas where many employment opportunities require tertiary education. Thus, urban women with secondary or lower education may be less likely to be gainfully employed, lacking the economic resources to adopt or continue using modern methods. The benefits of tertiary education is not limited to the individual woman, but extends to that of her family and community at large. According to a 2009 report by the World Bank, national governments need to invest in tertiary education for sustained economic growth [174]. The increase in tertiary education was postulated to lead to increased innovation, entrepreneurship, and technological capability to create more productive jobs, engage in a wider range of exports, and create multiple linkages with other governments or trans-national organizations [174]. Increased national economic growth has been linked to better quality of life for the citizenry. A gender analysis of enrollment in Nigerian universities revealed that despite the low rates of university enrollment, female enrollment in universities is considerably lower than male enrollment [175]. Keeping women in school beyond secondary education may lead to reductions in fertility rates in Nigeria. Additionally, FP interventions can be integrated into school health programs and will be a sure way to reach the young women in schools.

Women in-union. Urban women who had ever been married or had ever cohabitated with their male partners were found to have lower odds of using modern methods compared to single women. It is possible that these women in-union intend to get pregnant in the near future and as such are not in need of contraception. Nevertheless, FP interventions should target these women so that they have the correct information for whenever they need to practice FP. There is also a possibility that these women experience or perceive opposition to FP use from their male partners. Evidence show that women whose male partners oppose FP are less likely to use modern methods [50]. On the contrary, researchers have found positive associations between male partners' approval of FP and modern method use among

married women [39, 53, 76]. Spousal communication about fertility desires is suggested as the main factor that drives this positive association as many women wrongly assume that their partners oppose FP or want more children. Hence, one way to improve urban women's adoption, continued use, or switch from traditional methods to more effective modern methods is through encouraging discussions with male partners about desired fertility and FP use. This dissertation also provides evidence in support of such spousal discussions as urban women who reported discussing the number of children they wanted to have or the use of FP methods had higher odds of using modern methods compared to their counterparts who did not have such discussions. FP interventions should engage women and their partners to encourage discussions about fertility desires and need for FP use.

Muslim women. Many studies have found that Muslim women are less likely than Christian women to use modern methods [11, 33, 34, 42, 44, 49, 53, 54]. As shown in this dissertation, this negative association also holds true for urban Muslim women. FP is permissible in Islam [55] so it is likely that other sociocultural factors within Muslim communities are discouraging the practice of FP. Thus, FP interventions should find innovative ways to reach these women. One way to do so may be to involve the religious leaders or Muslim opinion leaders who are held to high standards in these communities. A recent study found that urban men in Senegal who heard a religious leader (mostly Imams) speak in favor of FP were more likely to report using modern methods [176]. It is possible that similar results may be observed for urban Muslim women. Another way to increase the modern method use among Muslim women is through media campaigns that promote small family sizes and the benefits of practicing FP. Such media campaigns are likely to reach not just the women, but also the men. A study conducted in Mali, a predominately Muslim country, to evaluate the impact of a FP multimedia program that included messages that Islam does not oppose FP found positive effects as the proportion of men and women who believed that Islam opposed FP decreased while the proportion that intended to use a modern method in the future increased over the six-month study period [153]. Such an intervention may work in Nigeria.

FP interventions at the community-level

FP interventions should aim to increase MCPR in the following urban communities:

Poor communities. According to the World Bank, about two-thirds of urban residents live below \$2 per day [177]. Urban poor communities experience inequalities in access to services, housing, land, education, healthcare, and employment opportunities. Unemployment rates are high in urban poor communities. Most of the urban poor residents who are employed work in the informal sector and as such are vulnerable to economic shocks in a cash economy like Nigeria. Also, many urban poor communities do not have access to healthcare as they have an inadequate number of health facilities and poor quality of services [177]. Thus, women who live in urban poor communities may need to travel a distance to get to a health facility that provides quality FP services; this may likely decrease their chances of using modern methods. Thus, one way to increase the health and wellbeing, including MCPR, among women living in urban poor communities may be to develop, implement, and evaluate poverty alleviation interventions within their communities.

In 2001, the Nigerian government approved a program aimed at eradicating absolute poverty in all states in Nigeria – the National Poverty Eradication Programme (NAPEP) [178-180]. The objectives of NAPEP are classified into four schemes; 1) youth empowerment scheme: to provide capacity acquisition, support internships, and create a micro-credit delivery system; 2) rural infrastructure development scheme: to improve transportation, energy, water, and communication infrastructure in rural areas; 3) social welfare services scheme: to provide social services such as special education, primary healthcare service, food security, micro and macro credits; and 4) natural resources development and conservation scheme: to harness agricultural, water, and solid mineral resources and to protect the environment [178-180]. However, many believe NAPEP has not been successful as poverty levels continue to increase [179, 180]. Some of the problems faced by NAPEP include poor targeting mechanisms, failure to focus on the poor, inconsistency in program implementation, and corruption [180]. NAPEP is currently being implemented at the state and local government levels; however, it may be better to engage grassroots NGOs based within the communities. For example, the government should delegate the implementation of NAPEP programs to local organizations who know the community well and know what will work in the community. The Nigerian government should also put in place checks to ensure that those who participate in such programs are indeed poor and have the potential to benefit from the program. Such

programs should develop, test, and use poverty indicators as eligibility criteria for program participation. These standardized poverty indicators will also be used for program monitoring and evaluation. The government should invest in external program monitoring and evaluation that will ensure that the local organizations are held accountable for the resources received and their goals and objectives. The program monitoring and evaluation will also provide information on lessons learned for future programs.

Although NAPEP is a national program, there seems to be more emphasis on rural areas. The national government need to pay attention to the urban poor communities. A 2014 study found geographic disparity in poverty levels in Nigeria, with northern Nigeria having higher rates of poverty compared to southern Nigeria [179]. The study found that the proportion of people living below \$1 per day in Nigeria was highest in the north-west geopolitical zone (72%) and lowest in the south-east geopolitical zone (27%). Thus, there may be a need to target communities in the northern region of the country. In addition, voluntary FP programs have been shown to reduce poverty in developing countries [181]. Without controlling the dependency ratio, the financial burden on the working class will continue to increase and poverty will continue to grow. Thus, in addition to the aforementioned schemes, NAPEP need to include FP as a poverty alleviation tool. NAPEP can expand access to FP services through periodic community outreaches and/or mobile clinics, and can engage private organizations to promote FP as a social responsibility.

Northern communities. Many analyses utilizing data from national surveys like the DHS have consistently found that the prevalence of modern method use is lower in the northern region as compared to the southern region of Nigeria [23, 49]. The predominant religion in northern Nigeria is Islam while the predominant ethnic group is Hausa. Interestingly, studies have shown that Muslim women compared to Christian women, and Hausa women compared to Yoruba or Igbo women are less likely to report using modern methods [49]. Thus, it is not surprising that previous researchers have attributed the low use of modern methods in northern Nigeria to the religious and sociocultural norms of the region [27, 49, 53]. In addition, many sociocultural practices that are more prevalent in this region, as compared to the southern region, have been shown to adversely affect women's health and quality of life. Such practices include,

but are not limited to, early marriages, early childbearing, female genital mutilation, little/no female formal education, and inequitable attitudes towards women's status [175, 182, 183]. The findings from this dissertation support the existing evidence as women in northern cities (Kaduna and Zaria) had lower odds of using or adopting modern methods over the four-year study period. Thus, in order to improve MCPR in Nigeria, there is a need to focus attention on communities in northern Nigeria. Innovative interventions that effectively engage the hard-to-reach women in these communities such as young women, married women, and women who experience religious or social restrictions should be developed, implemented, and evaluated. Such interventions should include men and religious leaders. Since Nigeria is a patriarchal society, FP interventions that involve male partners and other male opinion leaders such as religious leaders may be more likely to show positive outcomes.

Communities where large family size is still desirable. One of the findings of this dissertation was that women who lived in communities where other women wanted five or more children had lower odds of using modern methods while those who lived in communities where other women wanted fewer than five children had higher odds of using modern methods. This finding supports previous research that found that the ideal family size at the individual and community levels have negative associations with modern method use [37, 58, 59, 76]. Research from Nigeria indicates that large family size remains the norm and may be contributing to the low prevalence of modern method use [23, 76]. Thus, FP interventions need to promote small family size as way to achieve better quality of life. Programs that promote small family size have been shown to reduce fertility over time [181]. Thus, it may be beneficial to design programs that target communities where large family size are desirable. Every FP intervention should be preceded by a community needs assessment to understand the peculiar needs and characteristics of the target community and to design programs that will cater to such needs. Such programs need to be multipronged and should include a monitoring and evaluation component to track and measure set goals. One component to include in programs targeting communities where large family size remains desirable is mass-media awareness campaign that highlights the benefits of small family size and dispel myths and concerns about FP use. Evidence from Nigeria indicates that such media campaigns increase knowledge, ideation, and use of modern methods [115, 154, 184, 185].

Communities where gender inequality still exists. The findings from this dissertation indicated that urban women who themselves hold or live in communities that hold inequitable attitudes towards gender equality had lower probability of modern method adoption and continuation, and higher probability of method discontinuation. This finding is in line with previous evidence on the negative association between women's status and prevalence of modern method use as seen in many developing countries including Nigeria [36, 42, 70-72]. Inequitable gender norms act as social constraints that decrease women's self-efficacy to engage in healthy behaviors and/or seek services for their health needs. Keleher & Franklin (2008) in their review of evidence on the best way to change inequitable gender norms reported that interventions can be implemented at the level of the individual (downstream intervention), community (midstream intervention), or population (upstream intervention) [157]. The authors recommended programs that use a combination of interventions at multiple levels to produce synergistic effects.

An intervention that includes a combination of downstream and midstream components may work better in communities where gender inequality exists. The downstream intervention component may target women to build their self-efficacy towards fertility control while the midstream intervention component targets the entire community. Women can be reached individually in the homes, at their workplace, or within their communities by community health workers or through community outreach programs. The midstream intervention may entail community advocacy and engagement and/or media campaigns. Evaluation of previous media campaigns on FP implemented in some Nigerian cities showed positive effects on attitudes toward and adoption of modern methods [40, 115]. Thus, including female empowerment messaging in such campaigns has the potential to increase gender-equitable norms, and in turn improve, not just FP practice, but other aspects of women's health. Strategies for national (upstream) interventions may include policies to increase female education and economic empowerment, and/or reduce gender-based practices that harm women (e.g., violence against women, female genital mutilation, early marriages). The Federal Ministry of Women Affairs and Social Development in Nigeria should engage domestic and international organizations to develop, implement, and evaluate multi-

strategy programs that include combinations of all three levels of interventions aimed at eliminating gender inequality in Nigeria.

Limitations and Directions for Future Research

Despite the evidence provided by this dissertation, several research gaps still exist in the field of FP in urban contexts in Nigeria. Future research should explore the following topics:

Definition of urban community. Many previous studies that examined contextual effects defined 'communities' using census enumeration areas [36, 37, 39, 87, 92]. In surveys with multi-stage sampling designs like the DHS, these enumeration areas are used as the primary sampling units and are referred to as clusters. These clusters, which are from the most recent national censuses, are confined within a geographic boundary but are typically not of equal sizes or boundaries [186]. A sample is then selected from a cluster to represent the population within that geographic location. For example, the DHS program utilizes a two-stage cluster sampling design with an average cluster size of 100-300 households to obtain a sample of about 20-30 women per cluster [186]. In a rural area, a cluster may include the entire village as they are usually less populated. However, in the densely-populated urban areas, a cluster may include only a block of flats or households, typically on the same street. Depending on the associations being evaluated, cluster averages may or may not be suitable proxies for community effects. For example, estimates of the effects of social interactions on outcomes in a rural community is likely to be more appropriate as the residents of that village experience similar culture, beliefs, and norms. This may not be the case in urban clusters where residents come from diverse backgrounds and cultures and social interactions may not be confined to the smaller geographic boundaries [187]. This urban-rural differential was confirmed in a 2006 DHS study where the authors found that the intra-cluster correlation was stronger in rural areas compared to urban areas [186]. The strength of intra-cluster correlation indicates the level of similarities among women in the same cluster. The lower intra-cluster correlation among urban residents points to the fact that they may be interacting more with people outside their clusters (e.g. at the workplace or school). Thus, there is a need to understand what '*community*' means in urban settings in order to better model its effects on behaviors or health outcomes of the residents.

In this dissertation, an urban community was defined as an enumeration area – a cluster. A sample of 41 households was obtained from each cluster resulting in about 5-71 women per cluster. The assumption that women from these households represented a ‘community’ may not hold and may be the reason no associations were found between modern method use and some of the contextual exposure variables. Future research should explore what constitutes an ‘urban community’ or what a ‘community’ means in an urban setting. It may be necessary to use social network analysis to track and measure the interactions among urban residents. A social network is a web of social relationships or interactions between and among individuals [188]. Social network analysis is both a research theory and a methodology that explores the characteristics of dyadic relationships within a network and the effects of such characteristics on the behaviors or outcomes of network members [188]. Social network analysis is especially useful for understanding complex interactions, making its use appropriate for studying social interactions in an urban setting. It uses both qualitative and quantitative data. Although social network analysis does not impose geographical boundary on the interactions, it requires members of the network to share certain characteristics such as family, friendship, or work groups [188]. Some key constructs measured by network analysis include density of the network, homogeneity of network members, strength of network ties, and geographic dispersion of network members. Social network analysis may contribute to a more appropriate definition of urban community. It may also provide better estimates of the contextual effects on at-risk individuals not confined within geographic boundaries such as young women, women in-union, and Muslim women.

Mechanisms to link multiple data sources from multiple socioecological levels. In this dissertation, data from facility surveys were linked to data from the household-based women’s survey conducted within the same clusters to provide information on access to FP services in the health facilities within one-kilometer radius of the women’s cluster of residence. Linking the data from these surveys helped provide information on multiple levels of the socioecological system. No associations were found between the institutional-level factors and modern method use. Although this finding indicates the relative importance of other socioecological determinants of modern method use such as that of individual and community economic factors, it may also be a result of measurement error. One source of measurement error may

be from the distance used. A sensitivity analysis was conducted on the choice of distance (one, two, or five kilometers); however, the distance measured was from the health facility to the centroid of the clusters and not to the households. Directly linking the facilities to the women's households was not possible because of confidentiality and ethical issues. Another potential source of measurement error may be from the assumption that women visit the facilities in close proximity to their residence. This assumption may not hold in urban areas where women may find it more convenient to visit facilities in close proximity to their school or workplace. Additionally, data from the women were aggregated to the cluster level to provide information on contextual factors; this aggregation may not represent the true community effects. Future research should examine ways to better link women to facilities they use without breaching ethical boundaries. Likewise, there is a need to explore ways to provide a more comprehensive contextual picture, such as collecting appropriate community level qualitative and quantitative data and linking data from multiple levels of the socioecological system.

Concluding remarks

Nigeria continues to contribute immensely to the global maternal mortality. FP has been shown to contribute to the reduction of maternal deaths by decreasing the rates of unintended and high-risk pregnancies. The Nigerian Government recognizes the importance of FP to improving not just women's health but that of the entire population and thus aims to increase CPR by 5.25 percentage-points per annum from 2014 to 2018. In order to achieve this target, there is a need to develop, implement, and evaluate innovative multi-strategy FP interventions that will target both men and women but especially the at-risk populations. This dissertation provides scientific evidence and recommendations that may inform and support any such FP interventions targeting the urban population in Nigeria.

APPENDIX

Table A1: Definitions of recoded variables used in Chapter Three	
Variable name	Definition and calculation
Wealth Index	The variable was calculated using principal components analysis of these household items: electricity, radio, television, video player, telephone, mobile phone, landline, computer, fan, iron, clock, cable television, source of drinking water, toilet facility, cooking fuel, refrigerator, mosquito net, floor material, wall material, roof material, number of rooms in the house, separate room for kitchen, bicycle, motorcycle/scooter, any motor vehicle (car/van/truck), animal cart, boat with motor, own/rent land for agriculture, own other land, and own livestock. This household index score was used as a proxy for household economic status and divided into quintiles: poorest, poor, middle, rich, & richest households.
Self-efficacy towards FP use	An 8-item Likert scale with these statements was used to create the self-efficacy towards FP use score: • You could start a conversation with your partner about FP • You could convince your partner that you should use a method of FP • You could get to a place where FP methods are offered if you decided to use • You could obtain a FP method if you decided to use one • You could use a FP method even if your partner doesn't want you to • You could use a method of FP if none of your friends or neighbors uses one • You could use a FP method even if your religious leader did not think you should use one • You could continue to use a FP method if you experience some side effects The responses for each statements ranged from strongly agree (1) to strongly disagree (4) with a Cronbach's alpha of 0.93. The responses for each statement was dichotomized to '1' if strongly agree/agree or '0' if strongly disagree/disagree. These dichotomized responses were then summed and standardized to give a self-efficacy score ranging from 0 to 8.
FP access in health facilities	The following six dichotomous variables were summed and standardized to create the variable – access to health facilities: • At least one health facility within 1km radius of cluster • At least one health facility within 1km radius of cluster provides FP services • At least one health facility within 1km radius of cluster has a trained FP provider • At least one health facility within 1km radius of cluster provides ideal FP method mix. Ideal FP method mix at health facility is defined as having, in stock, one or more of each of the four categories – barrier methods, pills, injections, and long-acting or permanent methods (intrauterine device, implants, and/or sterilization). • At least one health facility within 1km radius of cluster did not have any method stock-out in the past year • At least one health facility within 1km radius of cluster does not require partner consent for contraceptive method provision The score ranges from 0 to 6 with increasing score meaning increasing access. The Cronbach's alpha is 0.69.

Table A1 continued	
FP access in pharmacies	The following six dichotomous variables were summed and standardized to create the variable – access to pharmacies: • At least one pharmacy within 1km radius of cluster • At least one pharmacy within 1km radius of cluster provides FP services • At least one pharmacy within 1km radius of cluster has a trained FP provider • At least one pharmacy within 1km radius of cluster provides ideal FP method mix. Ideal FP method mix at pharmacy is defined as having, in stock, one or more of each of the three categories – barrier methods, pills, and injections. • At least one pharmacy within 1km radius of cluster did not have any method stock-out in the past year • At least one pharmacy within 1km radius of cluster does not require partner consent for contraceptive method provision The score ranges from 0 to 6 with increasing score meaning increasing access. The Cronbach's alpha is 0.69
FP access in drug stores	The following six dichotomous variables were summed and standardized to create the variable – access to PMS: • At least one patent medicine store within 1km radius of cluster • At least one patent medicine store within 1km radius of cluster provides FP services • At least one patent medicine store within 1km radius of cluster has a trained FP provider • At least one patent medicine store within 1km radius of cluster provides ideal FP method mix. Ideal FP method mix at patent medicine stores is defined as having, in stock, one or more of each of the three categories – barrier methods, pills, and injections. • At least one patent medicine store within 1km radius of cluster did not have any method stock-out in the past year • At least one patent medicine store within 1km radius of cluster does not require partner consent for contraceptive method provision The score ranges from 0 to 6 with increasing score meaning increasing access. The Cronbach's alpha is 0.67.
FP: Family Planning	

REFERENCES

1. United Nations. The Millennium Development Goals Report 2015. New York: UN Department of Economics and Social Affairs; 2015.
2. World Health Organization. Trends in Maternal Mortality: 1990 to 2015. Estimates by WHO, UNICEF, UNFPA, World Bank and the United Nations Population Division. Geneva, Switzerland: WHO; 2015.
3. Starrs A. The safe motherhood action agenda: priorities for the next decade. New York: Family Care International; 1997.
4. World Health Organization. Health in 2015 from MDGs, Millennium Development Goals to SDGs, Sustainable Development Goals. Geneva: Switzerland: WHO; 2015.
5. National Population Commission. National policy on population for sustainable development. Abuja, Nigeria: National Population Commission; 2004.
6. Say L, Chou D, Gemmill A, Tunçalp Ö, Moller A-B, Daniels J et al. Global causes of maternal death: a WHO systematic analysis. *The Lancet Global Health*. 2014;2(6):e323-e33.
7. Winikoff B, Sullivan M. Assessing the role of family planning in reducing maternal mortality. *Studies in Family Planning*. 1987;18(3):128-43.
8. Fortney JA. The importance of family planning in reducing maternal mortality. *Studies in Family Planning*. 1987;18(2):109-14.
9. Canning D, Schultz TP. The economic consequences of reproductive health and family planning. *The Lancet*. 2012;380(9837):165-71.
10. Cleland J, Conde-Agudelo A, Peterson H, Ross J, Tsui A. Contraception and health. *The Lancet*. 2012;380(9837):149-56.
11. Adebawale SA, Fagbamigbe FA, Bamgboye EA. Contraceptive use: implication for completed fertility, parity progression and maternal nutritional status in Nigeria. *African Journal of Reproductive Health*. 2011;15(4):60-67.
12. Ahmed S, Li Q, Liu L, Tsui AO. Maternal deaths averted by contraceptive use: an analysis of 172 countries. *The Lancet*. 2012;380(9837):111-25.
13. Bankole A, Adewole I, Hussain R, Awolude O, Singh S, Akinyemi J. The incidence of abortion in Nigeria. *International Perspectives on Sexual and Reproductive Health*. 2015;41(4):170-81.
14. World Health Organization. Ensuring human rights in the provision of contraceptive information and services: guidance and recommendations. Geneva, Switzerland: Department of Reproductive Health and Research, WHO; 2014.
15. United Nations Population Information Network (POPIN). Report of the ICPD. UN Population Division, Department of Economic and Social Affairs with support from the UN Population Fund (UNFPA), Geneva, Switzerland. 1994. <http://www.un.org/popin/icpd/conference/offeng/poa.html>. Accessed July 24, 2014.
16. World Health Organization. Family planning and sex education of young people. *EURO Reports and Studies* 89. Copenhagen; 1982.

17. Welsh MJ, Stanback J, Shelton J. Access to modern contraception. *Best Practice & Research Clinical Obstetrics & Gynaecology*. 2006;20(3):323-38.
18. Togunde OR. Determinants of Women's Employment in Urban Nigeria: the Impact of Socio-Cultural Factors. *Journal of Asian and African Studies*. 1999;34(3):279-97.
19. Cleland J, Bernstein S, Ezeh A, Faundes A, Glasier A, Innis J. Family planning: the unfinished agenda. *The Lancet*. 2006;368(9549):1810-27.
20. Bongaarts J, Mauldin WP, Phillips JF. The demographic impact of family planning programs. *Studies in Family Planning*. 1990;21(6):299-310.
21. MEASURE Evaluation. Family planning and reproductive health indicators database. Carolina Population Center, Chapel Hill, NC. 2014. http://www.cpc.unc.edu/measure/prh/rh_indicators. Accessed July 22, 2014.
22. Alkema L, Kantorova V, Menozzi C, Biddlecom A. National, regional, and global rates and trends in contraceptive prevalence and unmet need for family planning between 1990 and 2015: a systematic and comprehensive analysis. *The Lancet*. 2013;381(9878):1642-52.
23. NPC Nigeria and ICF Macro. Nigeria Demographic and Health Survey, 2013. Calverton, MD: National Population Commission (NPC) Nigeria and ICF Macro; 2014.
24. Fotso JC, Ajayi JO, Idoko EE, Speizer I, Fasiku DA, Mberu B et al. Family Planning and Reproductive Health in Urban Nigeria: Levels, Trends and Differentials. Chapel Hill, NC: Measurement, Learning & Evaluation (MLE) Project [UNC, USA] and National Population Commission (NPC) [Nigeria]; 2011.
25. Asekun-Olarinmoye E, Adebimpe W, Bamidele J, Odu O, Asekun-Olarinmoye I, Ojofeitimi E. Barriers to use of modern contraceptives among women in an inner city area of Osogbo metropolis, Osun state, nigeria. *International Journal of Women's Health*. 2013;5:647-55.
26. Oye-Adeniran BA, Adewole IF, Umoh AV, Oladokun A, Gbadegesin A, Ekanem EE et al. Community-based study of contraceptive behaviour in Nigeria. *African Journal of Reproductive Health*. 2007;10(2):90-104.
27. Duze MC, Mohammed IZ. Male Knowledge, Attitude, and Family Planning Practices in Northern Nigeria. *African Journal of Reproductive Health*. 2007;10(3):53-65.
28. Darroch JE, Singh S. Trends in contraceptive need and use in developing countries in 2003, 2008, and 2012: an analysis of national surveys. *The Lancet*. 2013;381(9879):1756-62.
29. Casterline JB, Sinding SW. Unmet need for family planning in developing countries and implications for population policy. *Population and development review*. 2000;26(4):691-723.
30. Federal Ministry of Health. Nigeria Family Planning Blueprint (Scale-Up Plan). Abuja, Nigeria; 2014.
31. Campbell M, Sahin-Hodoglugil NN, Potts M. Barriers to fertility regulation: a review of the literature. *Studies in Family Planning*. 2006;37(2):87-98.
32. Bongaarts J, Frank O, Lesthaeghe R. The proximate determinants of fertility in sub-Saharan Africa. *Population and Development Review*. 1984;10(3):511-37.

33. Addai I. Does religion matter in contraceptive use among Ghanaian women? *Review of Religious Research*. 1999;40(3):259-77.
34. Levin A, Caldwell B, Khuda B-e. Effect of price and access on contraceptive use. *Social Science & Medicine*. 1999;49(1):1-16.
35. Do M, Fu H. Is Women's Self-Efficacy in Negotiating Sexual Decisionmaking Associated with Condom Use in Marital Relationships in Vietnam? *Studies in Family Planning*. 2011;42(4):273-82.
36. Paek H-J, Lee B, Salmon CT, Witte K. The contextual effects of gender norms, communication, and social capital on family planning behaviors in Uganda: a multilevel approach. *Health Education & Behavior*. 2008;35(4):461-77.
37. Elfstrom KM, Stephenson R. The role of place in shaping contraceptive use among women in Africa. *PloS One*. 2012;7(7):e40670.
38. Stephenson R, Baschieri A, Clements S, Hennink M, Madise N. Contextual influences on modern contraceptive use in sub-Saharan Africa. *American Journal of Public Health*. 2007;97(7):1233-40.
39. Kaggwa EB, Diop N, Storey JD. The role of individual and community normative factors: a multilevel analysis of contraceptive use among women in union in Mali. *International Family Planning Perspectives*. 2008;34(2):79-88.
40. Babalola S, Folda L, Babayaro H. The effects of a communication program on contraceptive ideation and use among young women in northern Nigeria. *Studies in Family Planning*. 2008;39(3):211-20.
41. Ketende C, Gupta N, Bessinger R. Facility-level reproductive health interventions and contraceptive use in Uganda. *International Family Planning Perspectives*. 2003;29(3):130-37.
42. OlaOlorun FM, Hindin MJ. Having a Say Matters: Influence of Decision-Making Power on Contraceptive Use among Nigerian Women Ages 35–49 Years. *PloS One*. 2014;9(6):e98702.
43. Magnani RJ, Hotchkiss DR, Florence CS, Shafer LA. The impact of the family planning supply environment on contraceptive intentions and use in Morocco. *Studies in Family Planning*. 1999;30(2):120-32.
44. Odimegwu CO. Family planning attitudes and use in Nigeria: a factor analysis. *International Family Planning Perspectives*. 1999;25(2):86-91.
45. Bronfenbrenner U. Toward an experimental ecology of human development. *American Psychologist*. 1977;32(7):513-31.
46. Bronfenbrenner U. *The ecology of human development: Experiments by design and nature*. Cambridge, MA: Harvard University Press; 1979.
47. McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Education & Behavior*. 1988;15(4):351-77.
48. Hossain SZ. Decision making, use of contraception and fertility in Bangladesh: A path analysis. *International Journal of Sociology and Social Policy*. 1998;18(7/8):27-55.
49. Adebayo SB, Gayawan E, Ujuju C, Ankomah A. Modelling geographical variations and determinants of use of modern family planning methods among women of reproductive age in Nigeria. *Journal of Biosocial Science*. 2013;45(1):57-77.

50. Teye JK. Modern contraceptive use among women in the Asuogyaman district of Ghana: is reliability more important than health concerns? *African Journal of Reproductive Health*. 2013;17(2):58-71.
51. Shapiro D, Tambashe BO. The impact of women's employment and education on contraceptive use and abortion in Kinshasa, Zaire. *Studies in Family Planning*. 1994;25(2):96-110.
52. Kravdal Ø. Education and fertility in sub-Saharan Africa: Individual and community effects. *Demography*. 2002;39(2):233-50.
53. Izugbara C, Ibisomi L, Ezeh AC, Mandara M. Gendered interests and poor spousal contraceptive communication in Islamic northern Nigeria. *Journal of Family Planning and Reproductive Health Care*. 2010;36(4):219-24.
54. Oye-Adeniran BA, Adewole IF, Umoh AV, Iwere N, Gbadegesin A. Induced abortion in Nigeria: Findings from focus group discussion. *African Journal of Reproductive Health*. 2005;9(1):133-41.
55. Shaikh BT, Azmat SK, Mazhar A. Family Planning and Contraception in Islamic Countries: A Critical Review of the Literature. *Journal of Pakistan Medical Association*. 2013;63(4):67-72.
56. Aisien A. Intrauterine contraceptive device (IUCD): acceptability and effectiveness in a tertiary institution. *African Journal of Medicine and Medical Sciences*. 2007;36(3):193-200.
57. Aisien A. Contraception with levonorgestrel subdermal implants (Norplant) in Benin-City Nigeria: A 12-year review. *African Journal of Reproductive Health*. 2013;11(1):76-89.
58. Bongaarts J, Casterline J. Fertility transition: is sub-Saharan Africa different? *Population and Development Review*. 2013;38(s1):153-68.
59. Madsen EL, Kuang B, Ross J. Tracking changes in states of contraceptive use over time in sub-Saharan Africa through cohort and period analysis. *Journal of Biosocial Science*. 2014:1-16.
60. Oye-Adeniran BA, Adewole IF, Umoh AV, Ekanem EE, Gbadegesin A, Iwere N. Community-based survey of unwanted pregnancy in southwestern Nigeria. *African Journal of Reproductive Health*. 2004;8(3):103-15.
61. Obisesan K, Adeyemo A, Fakokunde B. Awareness and use of family planning methods among married women in Ibadan, Nigeria. *East African Medical Journal*. 1998;75(3):135-8.
62. National Population Commission [Nigeria] and ICF Macro. Nigeria Demographic and Health Survey, 2008. Calverton, MD: National Population Commission and ICF Macro; 2009.
63. Mroz TA, Bollen KA, Speizer IS, Mancini DJ. Quality, accessibility, and contraceptive use in rural Tanzania. *Demography*. 1999;36(1):23-40.
64. Gueye A, Speizer IS, Corroon M, Okigbo CC. Belief in family planning myths at the individual and community levels and modern contraceptive use in urban Africa. *International Perspectives on Sexual and Reproductive Health*. 2015;41(4):191-9.
65. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review*. 1977;84(2):191-215.
66. Glanz K, Rimer BK, Viswanath K. Health behavior and health education: theory, research, and practice. 4th ed. John Wiley & Sons; 2008.

67. Strecher VJ, DeVellis BM, Becker MH, Rosenstock IM. The role of self-efficacy in achieving health behavior change. *Health Education & Behavior*. 1986;13(1):73-92.
68. Peyman N, Oakley D. Effective contraceptive use: an exploration of theory-based influences. *Health Education Research*. 2009;24(4):575-85.
69. Adedimeji AA, Heard NJ, Odutolu O, Omololu FO. Social factors, social support and condom use behavior among young urban slum inhabitants in southwest Nigeria. *East African Journal of Public Health*. 2009;5(3):215-22.
70. Upadhyay UD, Gipson JD, Withers M, Lewis S, Ciaraldi EJ, Fraser A et al. Women's empowerment and fertility: A review of the literature. *Soc Sci Med*. 2014;115. doi:10.1016/j.socscimed.2014.06.014.
71. Ahmed S, Creanga AA, Gillespie DG, Tsui AO. Economic status, education and empowerment: implications for maternal health service utilization in developing countries. *PLoS One*. 2010;5(6):e11190.
72. Corroon M, Speizer IS, Fotso JC, Akiode A, Saad A, Calhoun L et al. The role of gender empowerment on reproductive health outcomes in urban Nigeria. *Maternal and Child Health Journal*. 2014;18(1):307-15.
73. Adjiwanou V, LeGrand T. Gender inequality and the use of maternal healthcare services in rural sub-Saharan Africa. *Health & Place*. 2014;29:67-78.
74. Upadhyay UD, Karasek D. Women's empowerment and ideal family size: An examination of DHS empowerment measures in sub-Saharan Africa. *International Perspectives on Sexual and Reproductive Health*. 2012;38(2):78-89.
75. Bukar M, Audu B, Usman H, El-Nafaty A, Massa A, Melah G. Gender attitude to the empowerment of women: An independent right to contraceptive acceptance, choice and practice. *Journal of Obstetrics & Gynaecology*. 2013;33(2):180-3.
76. Isiugo-Abanihe UC. Reproductive motivation and family-size preferences among Nigerian men. *Studies in Family Planning*. 1994;25(3):149-61.
77. Casterline JB, Sathar ZA, Haque M. Obstacles to contraceptive use in Pakistan: A study in Punjab. *Studies in Family Planning*. 2001;32(2):95-110.
78. Babalola S, Vondrasek C, Brown J, Traoré R. The impact of a regional family planning service promotion initiative in sub-Saharan Africa: evidence from Cameroon. *International Family Planning Perspectives*. 2001;27(4):186-216.
79. Dynes M, Stephenson R, Rubardt M, Bartel D. The influence of perceptions of community norms on current contraceptive use among men and women in Ethiopia and Kenya. *Health & Place*. 2012;18(4):766-73.
80. Adinma J, Okeke A. The pill: perceptions and usage among Nigerian students. *Advances in Contraception*. 1993;9(4):341-9.
81. Obi S, Ozumba B. Emergency contraceptive knowledge and practice among unmarried women in Enugu, southeast Nigeria. *Nigerian Journal of Clinical Practice*. 2009;11(4):296-9.
82. Bertrand JT, Hardee K, Magnani RJ, Angle MA. Access, quality of care and medical barriers in family planning programs. *International Family Planning Perspectives*. 1995;21(2):64-74.

83. RamaRao S, Lacuesta M, Costello M, Pangolibay B, Jones H. The link between quality of care and contraceptive use. *International Family Planning Perspectives*. 2003;29(2):76-83.
84. Kim Y-M, Rimon J, Winnard K, Corso C, Mako I, Lawal S et al. Improving the quality of service delivery in Nigeria. *Studies in Family Planning*. 1992;23(2):118-27.
85. Bruce J. Fundamental elements of the quality of care: a simple framework. *Studies in Family Planning*. 1990;21(2):61-91.
86. Steele F, Curtis SL, Choe M. The Impact of Family Planning Service Provision on Contraceptive-Use Dynamics in Morocco. *Studies in Family Planning*. 1999;30(1):28-42.
87. Ejembi CL, Dahiru T, Aliyu AA. Contextual factors influencing modern contraceptive use in Nigeria. *DHS Working Papers*. No. 120. Rockville, Maryland, USA: ICF International; 2015.
88. Mandara M. Family planning in Nigeria and prospects for the future. *International Journal of Gynecology & Obstetrics*. 2012;117(1):1-4.
89. Mabsout R, Van Staveren I. Disentangling bargaining power from individual and household level to institutions: Evidence on women's position in Ethiopia. *World Development*. 2010;38(5):783-96.
90. Burgard SA, Lee-Rife SM. Community characteristics, sexual initiation, and condom use among young Black South Africans. *Journal of Health and Social Behavior*. 2009;50(3):293-309.
91. DeGraff DS, Bilsborrow RE, Guilkey DK. Community-level determinants of contraceptive use in the Philippines: A structural analysis. *Demography*. 1997;34(3):385-98.
92. Uthman OA, Kongnyuy EJ. A multilevel analysis of effect of neighbourhood and individual wealth status on sexual behaviour among women: Evidence from Nigeria 2003 Demographic and Health Survey. *BMC International Health and Human Rights*. 2008;8(1):9-15.
93. Babalola S, Fatusi A. Determinants of use of maternal health services in Nigeria-looking beyond individual and household factors. *BMC Pregnancy and Childbirth*. 2009;9(1):43.
94. Gordon C, Sabates R, Bond R, Wubshet T. Women's education and modern contraceptive use in Ethiopia. *International Journal of Education*. 2011;3(1):E9.
95. Ezeh AC, Kodzi I, Emina J. Reaching the urban poor with family planning services. *Studies in Family Planning*. 2010;41(2):109-16.
96. Magadi MA, Zulu EM, Brockerhoff M. The inequality of maternal health care in urban sub-Saharan Africa in the 1990s. *Population Studies*. 2003;57(3):347-66.
97. Bongaarts J. The impact of family planning programs on unmet need and demand for contraception. *Studies in Family Planning*. 2014;45(2):247-62.
98. Lapham RJ, Mauldin WP. Contraceptive prevalence: the influence of organized family planning programs. *Studies in Family Planning*. 1985;16(3):117-37.
99. Tsui AO. Population policies, family planning programs, and fertility: The record. *Population and Development Review*. 2001;27:184-204.
100. Lloyd CB, Kaufman CE, Hewett P. The spread of primary schooling in sub-Saharan Africa: implications for fertility change. *Population and Development Review*. 2000;26(3):483-515.

101. Bandura A. Social Learning Theory. Englewood Cliffs, NJ: Prentice-Hall; 1977.
102. Bandura A. Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall; 1986.
103. Connell RW. Gender and Power. Stanford, CA: Stanford University Press; 1987.
104. Wingood GM, DiClemente RJ. Application of the theory of gender and power to examine HIV-related exposures, risk factors, and effective interventions for women. *Health Education & Behavior*. 2000;27(5):539-65.
105. Wingood GM, DiClemente RJ. The Theory of Gender and Power: a social structural theory for guiding public health interventions. In: DiClemente RJ, Crosby RA, Kegler MC, editors. *Emerging theories in health promotion practice and research: strategies for improving public health*. . San Francisco, CA: Jossey-Bass; 2002. p. 313-45.
106. Sedgh G, Bankole A, Oye-Adeniran B, Adewole IF, Singh S, Hussain R. Unwanted pregnancy and associated factors among Nigerian women. *International Family Planning Perspectives*. 2006;32(4):175-84.
107. Mitsunaga TM, Larsen UM, Okonofua FE. Risk factors for complications of induced abortions in Nigeria. *Journal of Women's Health*. 2005;14(6):515-28.
108. Omideyi AK, Akinyemi AI, Aina OI, Adeyemi AB, Fadeyibi OA, Bamiwuye SO et al. Contraceptive practice, unwanted pregnancies and induced abortion in Southwest Nigeria. *Global Public Health*. 2011;6(1):s52-s72.
109. Okonofua FE, Odimegwu C, Ajabor H, Daru PH, Johnson A. Assessing the prevalence and determinants of unwanted pregnancy and induced abortion in Nigeria. *Studies in Family Planning*. 1999;30(1):67-77.
110. Aremu O. The influence of socioeconomic status on women's preferences for modern contraceptive providers in nigeria: a multilevel choice modeling. *Patient Preference and Adherence*. 2013;7:1213-20.
111. Balogun O, Raji H. Clinical experience with injectable progestogen-only contraceptives at University of Ilorin teaching hospital: a five year review. *The Nigerian Postgraduate Medical Journal*. 2009;16(4):260-3.
112. Olatinwo A, Anate M, Balogun O, Alao M. Intrauterine contraceptive device (IUCD): socio-demographic characteristics of acceptors, acceptability and effectiveness in a teaching hospital in Nigeria. *Nigerian Journal of Medicine*. 2001;10(1):14-7.
113. Roberts A, Obajimi G. An audit of interval female sterilisation by minilaparotomy at the University College Hospital, Ibadan, Nigeria. *Journal of Obstetrics & Gynaecology*. 2013;33(4):403-5.
114. Onwujekwe OE, Ogbonna C, Uguru N, Uzochukwu BS, Lawson A, Nduyabangi B. Increasing access to modern contraceptives: the potential role of community solidarity through altruistic contributions. *International Journal for Equity in Health*. 2012;11(1):34-42.
115. Piotrow PT, Rimon JG, Winnard K, Kincaid DL, Huntington D, Convisser J. Mass media family planning promotion in three Nigerian cities. *Studies in Family Planning*. 1990;21(5):265-74.

116. Ezebialu I, Eke A. Knowledge and practice of emergency contraception among female undergraduates in South Eastern Nigeria. *Annals of Medical and Health Sciences Research*. 2014;3(4):541-5.
117. Ebuehi O, Ekanem E, Ebuehi O. Knowledge and practice of emergency contraception among female undergraduates in the University of Lagos, Nigeria. *East African Medical Journal*. 2006;83(3):90-5.
118. United Nations. *World Urbanization Prospects: The 2014 Revision (ST/ESA/SER.A/366)*. New York: United Nations, Department of Economic and Social Affairs, Population Division; 2015.
119. UNFPA. *The state of world population 2007: unleashing the potential of urban growth*. New York: United Nations Population Fund; 2007.
120. Kessides C. *The urban transition in sub-Saharan Africa: implications for economic growth and poverty reduction*. Washington, DC: Cities Alliance; 2006.
121. Al Riyami A, Afifi M, Mabry RM. Women's autonomy, education and employment in Oman and their influence on contraceptive use. *Reproductive Health Matters*. 2004;12(23):144-54.
122. Thaddeus S, Maine D. Too far to walk: maternal mortality in context. *Social Science & Medicine*. 1994;38(8):1091-110.
123. Ronsmans C, Etard J-F, Walraven G, Høj L, Dumont A, Bernis Ld et al. Maternal mortality and access to obstetric services in West Africa. *Tropical Medicine & International Health*. 2003;8(10):940-8.
124. Dodoo F, Zulu EM, Ezech AC. Urban–rural differences in the socioeconomic deprivation–sexual behavior link in Kenya. *Social Science & Medicine*. 2007;64(5):1019-31.
125. U.S. Agency for International Development (USAID). *Property rights and resource governance country profile: Nigeria*. USAID. 2010. <http://usaidlandtenure.net/nigeria>. Accessed July 24, 2014.
126. Central Intelligence Agency (CIA). *The World Factbook: Nigeria*. 2015. <https://www.cia.gov/library/publications/the-world-factbook/geos/ni.html>. Accessed September 28, 2015.
127. Maps of the World. *Detailed administrative map of Nigeria with cities*. 2015. <http://www.vidiani.com/detailed-administrative-map-of-nigeria-with-cities>. Accessed September 29, 2015.
128. U.S. Library of Congress. *Nigeria: Geography*. . 2015. <http://countrystudies.us/nigeria/32.htm>. Accessed September 29, 2015.
129. U.S. Library of Congress. *Nigeria: Climate*. . 2015. <http://countrystudies.us/nigeria/33.htm>. Accessed September 29, 2015.
130. Organization of the Petroleum Exporting Countries (OPEC). *Nigeria facts and figures*. . 2015. http://www.opec.org/opec_web/en/about_us/167.htm. Accessed September 29, 2015.
131. Federal Ministry of Health. *National strategic health development plan (NSHDP) 2010 - 2015*. Abuja, Nigeria. FMOH; 2010.

132. PRB. World Population Data Sheet with a special focus on women's empowerment. Population Reference Bureau (PRB). 2015. http://www.prb.org/pdf15/2015-world-population-data-sheet_eng.pdf. Accessed September 22, 2015.
133. The World Bank Group. Nigeria: Country Data. 2015. <http://data.worldbank.org/country/nigeria?display=map>. Accessed September 22, 2015.
134. National Population Commission (NPC) Nigeria. State Population. 2015. <http://population.gov.ng/index.php/state-population>. Accessed September 29, 2015.
135. Demographia World Urban Areas: 11th Annual Edition: 2015.01 (Built-Up Urban Areas or World Agglomerations). 2015. <http://www.demographia.com/db-worldua.pdf>. Accessed September 29, 2015.
136. Guo G, Zhao H. Multilevel modeling for binary data. *Annual Review of Sociology*. 2000;26:441-62.
137. Uchudi J. Spouses' socioeconomic characteristics and fertility differences in sub-Saharan Africa: does spouse's education matter? *Journal of Biosocial Science*. 2001;33(4):481-502.
138. Oyediran KA, Feyisetan OI, Akpan T. Predictors of condom-use among young never-married males in Nigeria. *Journal of Health, Population and Nutrition*. 2011;29(3):273-85.
139. High-Level Task Force for ICPD. Policy recommendations for the ICPD beyond 2014: sexual and reproductive health and rights for all. New York: International Planned Parenthood Federation/Western Hemisphere Region (IPPF/WHR); 2013.
140. MLE Project. Measurement, Learning & Evaluation Project for the Urban Reproductive Health Initiative. 2013. www.urbanreproductivehealth.org. Accessed August 5, 2014.
141. Hox J. Multilevel modeling: when and why. In: Balderjahn I, Mathar R, Schader M, editors. *Classification, data analysis, and data highways*. New York: Springer Verlag; 1998. p. 147-54.
142. Merlo J, Chaix B, Ohlsson H, Beckman A, Johnell K, Hjerpe P et al. A brief conceptual tutorial of multilevel analysis in social epidemiology: using measures of clustering in multilevel logistic regression to investigate contextual phenomena. *Journal of Epidemiology and Community Health*. 2006;60(4):290-7.
143. Rabe-Hesketh S, Skrondal A, Pickles A. Maximum likelihood estimation of limited and discrete dependent variable models with nested random effects. *Journal of Econometrics*. 2005;128(2):301-23.
144. Rabe-Hesketh S, Skrondal A, Pickles A. GLLAMM manual. U.C. Berkeley Division of Biostatistics Working Paper Series: University of California, Berkeley; 2004.
145. Rabe-Hesketh S, Skrondal A. Multilevel and longitudinal modeling using Stata. Volume II: categorical responses, counts, and survival. Third ed. College Station, TX: Stata Press; 2012.
146. Angeles G, Cronin C, Guilkey DK, Lance PM, Sullivan B. A guide to longitudinal program impact evaluation. Chapel Hill, NC: Measurement, Learning & Evaluation Project; 2014.
147. McAlister AL, Perry CL, Parcel GS. How individuals, environments, and health behaviors interact: social cognitive theory. In: Glanz K, Rimer BK, Viswanath K, editors. *Health behavior and health education: theory, research, and practice*. 4th ed. San Francisco, CA: Jossey-Bass; 2008. p. 169-88.

148. MLE Project, NURHI, NPC Nigeria. 2010 – 2011 Nigeria Baseline Survey for the Urban Reproductive Health Initiative. Chapel Hill, NC, USA: Measurement, Learning & Evaluation [MLE] Project; Nigerian Urban Reproductive Health Initiative [NURHI]; National Population Commission [NPC] Nigeria; 2011.
149. MLE Project, NURHI, DRMC. Report of the Baseline Facility Survey for the Nigerian Urban Reproductive Health Initiative (NURHI). Chapel Hill, NC: Measurement Learning & Evaluation [MLE] Project; Nigerian Urban Reproductive Health Initiative [NURHI]; Data Mapping and Research Consult [DRMC]; 2011.
150. Clarke P. When can group level clustering be ignored? Multilevel models versus single-level models with sparse data. *Journal of Epidemiology and Community Health*. 2008;62(8):752-8.
151. StataCorp. Stata Statistical Software: Release 14. College Station, TX: StataCorp LP; 2015.
152. Halpern V, Lopez LM, Grimes DA, Stockton LL, Gallo MF. Strategies to improve adherence and acceptability of hormonal methods of contraception. *Cochrane Database of Systematic Review*. 2013;10(CD0043317).
153. Kane TT, Gueye M, Speizer I, Pacque-Margolis S, Baron D. The impact of a family planning multimedia campaign in Bamako, Mali. *Studies in Family Planning*. 1998;29(3):309-23.
154. Bankole A, Rodriguez G, Westoff CF. Mass media messages and reproductive behaviour in Nigeria. *Journal of Biosocial Science*. 1996;28(2):227-39.
155. Ezeh AC. Polygyny and reproductive behavior in sub-Saharan Africa: A contextual analysis. *Demography*. 1997;34(3):355-68.
156. Sedgh G, Hussain R. Reasons for contraceptive nonuse among women having unmet need for contraception in developing countries. *Studies in Family Planning*. 2014;45(2):151-69.
157. Keleher H, Franklin L. Changing gendered norms about women and girls at the level of household and community: a review of the evidence. *Global Public Health*. 2008;3(S1):42-57.
158. Upadhyay UD, Gipson JD, Withers M, Lewis S, Ciaraldi EJ, Fraser A et al. Women's empowerment and fertility: A review of the literature. *Social Science & Medicine*. 2014;115:111-20.
159. Shimamoto K, Gipson JD. The relationship of women's status and empowerment with skilled birth attendant use in Senegal and Tanzania. *BMC Pregnancy & Childbirth*. 2015;15:154. doi:10.1186/s12884-015-0591-3.
160. White D, Dynes M, Rubardt M, Sissoko K, Stephenson R. The influence of intrafamilial power on maternal health care in Mali: perspectives of women, men and mothers-in-law. *International Perspectives on Sexual and Reproductive Health*. 2013;39(2):58-68.
161. Crissman HP, Adanu RM, Harlow SD. Women's sexual empowerment and contraceptive use in Ghana. *Studies in Family Planning*. 2012;43(3):201-12.
162. United Nations Population Fund (UNFPA). Gender at the heart of ICPD: The UNFPA strategic framework on gender mainstreaming and women's empowerment. New York: UNFPA; 2011.
163. Kabeer N. Resources, agency, achievements: reflections on the measurement of women's empowerment. In: Sisask A, editor. *Discussing Women's Empowerment - Theory and Practice*. Stockholm, Sweden. 2001.

164. Mandara MU. Female genital mutilation in Nigeria. *International Journal of Gynecology & Obstetrics*. 2004;84(3):291-8.
165. Malhotra A, Schuler SR. Women's empowerment as a variable in international development. In: Narayan D, editor. *Measuring empowerment: cross-disciplinary perspectives*. Washington DC; 2005. p. 71-88.
166. Fawole OI, Adeoye IA. Women's status within the household as a determinant of maternal health care use in Nigeria. *African Health Sciences*. 2015;15(1):217-25.
167. Measurement Learning & Evaluation (MLE) Project, National Population Council (NPC), Data Research and Mapping Consult Ltd. *Measurement, Learning & Evaluation of the Urban Reproductive Health Initiative: Nigeria 2014 Endline Survey*. [TWP 2-2015]. Chapel Hill, NC, USA: Measurement, Learning & Evaluation Project; 2015.
168. Antai D, Adaji S. Community-level influences on women's experience of intimate partner violence and terminated pregnancy in Nigeria: a multilevel analysis. *BMC Pregnancy and Childbirth*. 2012;12(1):128-43.
169. Antai D, Antai J. Attitudes of women toward intimate partner violence: a study of rural women in Nigeria. *Rural Remote Health*. 2008;8(3):996.
170. Do M, Kurimoto N. Women's Empowerment and Choice of Contraceptive Methods in Selected African Countries. *Int Perspect Sex Reprod Health*. 2012;38. doi:10.1363/3802312.
171. Okenwa L, Lawoko S, Jansson B. Contraception, reproductive health and pregnancy outcomes among women exposed to intimate partner violence in Nigeria. *The European Journal of Contraception and Reproductive Health Care*. 2011;16(1):18-25.
172. Oyedokun AO. Domestic violence and constrained contraceptive choices in selected areas of Osun State, Nigeria. *Sexual and Relationship Therapy*. 2008;23(4):305-23.
173. Bajoga UA, Atagame KL, Okigbo CC. Media influence on sexual activity and contraceptive use: A cross-sectional survey among young women in urban Nigeria. *African Journal of Reproductive Health*. 2015;19(3):100-10.
174. The World Bank. *Accelerating catch-up: tertiary education for growth in sub-Saharan Africa*. Washington DC: The World Bank; 2009.
175. Adeyemi K, Akpotu N. Gender analysis of student enrolment in Nigerian universities. *Higher Education*. 2004;48(3):361-78.
176. Okigbo CC, Speizer IS, Corroon M, Gueye A. Exposure to family planning messages and modern contraceptive use among men in urban Kenya, Nigeria, and Senegal: a cross-sectional study. *Reproductive health*. 2015;12(1):63.
177. Baker JL. *Urban poverty: a global view*. Urban Papers. Washington DC: The World Bank; 2008.
178. Bindir UB. *The National Poverty Eradication Programme (NAPEP): monitoring strategies*. Community-based Monitoring and Evaluation Methodology Workshop; Washington DC: The World Bank & Food Basket Foundation International; 2002.
179. Anyebe AA. Poverty reduction in Nigeria via National Poverty Eradication Programme (NAPEP): Two decades of policy failure? *Journal of Social Science for Policy Implications*. 2014;2(2):19-35.

180. Ugoh SC, Ukpere WI. Appraising the trend of policy on poverty alleviation programmes in Nigeria with emphasis on a National Poverty Eradication Programme (NAPEP). *African Journal of Business Management*. 2009;3(12):847-54.
181. Bongaarts J, Cleland J, Townsend JW, Bertrand JT, Gupta MD. Family planning programs for the 21st century: rationale and design. New York: NY: Population Council; 2012.
182. Melah G, Massa A, Yahaya U, Bukar M, Kizaya D, El-Nafaty A. Risk factors for obstetric fistulae in north-eastern Nigeria. *Journal of Obstetrics & Gynecology*. 2007;27(8):819-23.
183. Gayawan E, Adebayo SB. Spatial pattern and determinants of age at marriage in Nigeria using a geo-additive survival model. *Mathematical Population Studies*. 2014;21(2):112-24.
184. Speizer IS, Corroon M, Calhoun L, Lance P, Montana L, Nanda P et al. Demand generation activities and modern contraceptive use in urban areas of four countries: a longitudinal evaluation. *Global Health: Science and Practice*. 2014;2(4):410-26.
185. Krenn S, Cobb L, Babalola S, Odeku M, Kusemiju B. Using behavior change communication to lead a comprehensive family planning program: the Nigerian Urban Reproductive Health Initiative. *Global Health: Science and Practice*. 2014;2(4):427-43.
186. Aliaga A, Ren R. Optimal sample sizes for two-stage cluster sampling in Demographic and Health Surveys. DHS Working Papers, No. 30. Calverton, MD: ORC Macro; 2006.
187. Montgomery MR, Ezech AC. Urban health in developing countries: insights from demographic theory and practice. In: Galea S, Vlahov D, editors. *Handbook of Urban Health: Populations, Methods, and Practice*. New York, NY: Springer; 2005. p. 317-60.
188. Heaney CA, Israel BA. Social networks and social support. In: Glanz K, Rimer BK, Viswanath K, editors. *Health behavior and health education: Theory, research, and practice*. San Francisco, CA: Jossey-Bass; 2008. p. 189-210.